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BILIARY SURGERY

FROM JANUARY, 1910, TO APRIL 10, 1914, WITH AN ANALYSIS OF 270 CASES

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DURING the period of time covered by this paper, 270 patients were operated upon, with 13 deaths, a mortality of 4+ per cent. The majority of these patients were subjected to operative interference upon more viscera than the gall-bladder alone, or the gall-bladder and duct were interfered with, thereby insuring a greater risk as to mortality than individual operations would give.

It is with a view of presenting the causes of death and the operations done that I offer this paper.

Age: This varied from 22 to 74 years.

Sex: The number of patients in whom the sex is recorded is 242; of these, 154 were females and 88 were males—rather a sharp contrast to the records of Whittemore of Boston, published in the *Boston Med. and Surg. Jour.*, October, 1913. He reported a series of 595 cases in which there were 441 women and 154 men; almost three times as many females as males.

Type of disease: My records show 54 cases of acute cholecystitis; 34 cases of gangrenous cholecystitis, and 115 cases of cholecystitis not otherwise classified—this series included all varieties, from non-inflammatory to hydrops. There were six cases of perforated cholecystitis; six non-calculous; four malignant, and eight cases of hydrops; cholangeitis 23 cases. In addition, acute hemorrhagic pancreatitis, with suppuration or sloughing, was observed 6 times.

The operations recorded were as follows: Cholecystostomy, 125 cases, with 5 deaths. Cholecystectomy, 96 cases, with 4 deaths. Choledochotomy and transduodenal choledochotomy, 5 cases in all with 2 deaths. Cholecystostomy, with choledochotomy, 17 cases, with one death. Cholecystectomy, with choledochotomy, 27 cases, with one death. Cholecystotomy, with and without combined operations upon the duct, 142 cases, with 6 deaths. Cholecystectomy, with and without combined operations upon the ducts, 123 cases with 5 deaths.

Here it will be well to note the relative mortality rates in these two types of operations as a prognostic factor in advising their performance. In the so-called lesser mortality type of operation, cholecystostomy, with and without combined operations upon the ducts, I report 142 cases, with 6 deaths, a mortality of 4.2 per cent., while in the graver operation of cholecystectomy, with and without combined operations upon the ducts, I report 123 cases with 5 deaths, a mortality of 4 + per cent. Attention is also called to the difference in the results after cholecystostomy alone, 125 cases with 5 deaths, and after cholecystectomy alone, 96 cases with 4 deaths, in both the mortality being less than 4 per cent.

Choledochostomy, singly or combined with operations upon the bladder, was done in 49 cases, with 4 deaths, about 8 per cent. If the choledochostomies, without additional bladder operations, be considered, the mortality in this series is exceptionally high, 5 choledochostomies of this class being done with a mortality of 2, or 40 per cent. These two deaths are easily explained: one occurred on the fourth day from embolism, and the other was due to a compression (interstitial fibrosis) of the liver cells in a patient 65 years old, in whom I opened the common duct, with negative findings, four years after a primary cholecystectomy and choledochotomy for pronounced cholangeitis. Added to the cellular change in the liver in this case was a marked nephritis, which was the final cause of her dissolution, as there was almost complete anuria for four days preceding her death.

Secondary operations: Under this term I include those patients who were operated on a second or a third time—not those considered as two-stage operations. I can find the histories of but 8 such cases in a series of 270, and these I will mention briefly. All were operated on by surgeons of repute, and I have no reason to doubt that the operations were as complete and thorough as the circumstances permitted. The following case presents a point of interest as to the length of time necessary for stones to grow to some size:

> Mrs. B. was operated on six years ago in one of our large hospitals, a cholecystostomy being done. She remained free from pain for about two years. Then all her former symptoms recurred with increased severity, and there were signs of duct involvement. I then operated on her, exposing a very long, adherent gall-bladder containing 33 stones, none of them smaller than a marrow-fat pea. Four stones about the same size were also found in the common duct. A cholecystectomy and choledochotomy were done, together with the removal of the appendix. The patient made a prompt recovery, with no recurrence of any kind up to the present time.

It is but fair to the operating surgeon in this case to assume that in a case of election, as this was, we can preclude the possibility of his leaving 33 large stones in the gall-bladder. Therefore, either these stones were conveyed as fairly sized ones from the liver into the bladder, or else the growth of stones in the gall-bladder can be very rapid. The common duct invasion must be considered by itself, as this part of the hepatic system was not operated upon at that time. We are all aware of the presence of hepatic stones, and in view of this established fact, I advance the above argument as to the possible migration from the liver to the gall-bladder.

The second patient in the series was a young woman who was operated on a year ago for an acute gangrenous (?) cholecystitis. No stone was found at the time. She came to me with a persisting fistula, and upon exposing her gall-bladder, a stone the size of a robin's egg was found. This stone, I am quite sure, was overlooked at the first operation. A cure was established in two weeks by doing a cholecystectomy.

The third patient was a physician in whom a cholecystostomy was done hurriedly two years ago in the Presbyterian Hospital for a suppurative condition, and, owing to profuse hemorrhage from the surrounding tissues, packing was resorted to. Two years later he again developed marked symptoms. With great difficulty I was able to do a successful cholecystectomy, with an appendectomy.

The fourth case was one of my own. The patient was a female, twenty-two years old, with an acute hemorrhagic pancreatitis. In addition to establishing very liberal drainage, I did a cholecystostomy, removing many stones, some of them the size of a marrow-fat pea. Speedy recovery took place, the drainage wound healing promptly. Only recently, about three years later, I was compelled to explore her for abdominal pains similar to those she had had before her first operation, with the result of finding an atrophied and contracted gall-bladder containing mucopus and an amber-colored stone, entirely different from those originally removed, and about the size of a very large marrow-fat pea, impacted in the cystic duct. A cholecystectomy and appendectomy were done, and speedy recovery followed.

The fifth patient was one in whom a rapid cholecystostomy was done twenty months ago in one of our large hospitals by a man of very extensive experience. When I saw the patient, she said she had had a period of eleven months' freedom, and then all her symptoms of a stone in the duct recurred. At this time the patient had a temperature of 103.6° and was profoundly jaundiced. An immediate operation revealed a small, purulent bladder and one large duct stone. Upon opening the common duct, no

bile escaped; in fact, acholia persisted for fifteen hours, and then only the slightest evidence of bile was present. Twelve hours later, however, bile began to flow in fair amount. In this case a cholecystectomy, choledochotomy and appendectomy were done, and the patient made an excellent recovery.

The last of the series I wish to report was in a Catholic priest of about forty years who was an athlete and worked hard in his parish. When I saw him, in consultation with Dr. Ludwig Kast, he said he was suffering from pain in his abdomen, similar to that in a previous attack, for which he had been operated on thirteen months before. That operation, I was informed, was a cholecystostomy and choledochostomy. Conditions arose that demanded an exploration. A cholecystostomy and choledochotomy were again done, retaining the gall-bladder because the common duct was very much thickened (cicatricial), and a chronic pancreatitis existed. The fact was kept in mind that it might be necessary at some future date to do a cholecystenterostomy.

This patient went through the most profound manifestations of shock and collapse for four days that it has ever been my misfortune to see, showing all the evidences of a severe toxæmia, similar to those observed in acute pancreatitis. It is now about one year since his second operation, and no biliary symptoms have been complained of.

Combined or additional operations other than those of the hepatic system:

Appendectomy: Over ten years ago I called attention to associated disease of the appendix, using the unfortunate term "dual disease" instead of coincident or associated. This fact was well borne out by the second operation upon one of our well-known western surgeons while on a visit to the east during the past few years. I always remove the appendix when the patient's condition permits it, or when the infection can be limited to the gall-bladder zone. In this series, I have done appendectomy with cholecystostomy 67 times; with cholecystectomy 49 times; with cholecystostomy and choledochostomy 6 times, and with cholecystectomy and choledochostomy 15 times, making a total of 137 appendectomies in the entire series, over 50 per cent. Of the above number, it happens that the appendix has occasionally been the primary offending member, and the gall-bladder the secondary. One patient with a gangrenous appendix gave a history of gall-bladder trouble for years; she was also two months pregnant. She had an appendectomy and cholecystostomy done without disturbing the pregnancy. In one case a Finney operation for pyloroplasty was done, and in one a gastroenterostomy with choledochostomy. A partial gastrectomy for car-

cinoma, with cholecystectomy and choledochotomy was done in a woman who was afterwards shown at a meeting of the New York Surgical Society. In this case, three years before, I had done a right nephrectomy, a right oöphorocystectomy and an appendectomy. This patient is living to-day, her second year terminating in two months.

Gastro-enterostomy for duodenal ulcer was done in two cases. A gastrotomy for ulcer on the posterior wall of the stomach was done in one case. In one case there was gastric carcinoma. In ten cases there were uterine and ovarian operations not requiring hysterectomy. In one of these there was a large cyst with a pedicle twisted several times. In seventeen of the cases the operation was associated with hysterectomy for fibroids. I have found the gall-bladder involved frequently in recent years in this condition, and, in my opinion, the patient's convalescence is scarcely retarded by these associated operations that are indicated.

In six of the cases there was an acute pancreatitis in the hemorrhagic, suppurative or sloughing stages of the disease. Five recovered. In all of them a cholecystostomy had been done. One, previously cited, was operated on recently, doing a cholecystectomy. In one there was a mucous fistula which persisted for two years and then healed spontaneously.

Carcinoma of the papilla of Vater was observed once. This patient was operated on twice, first a cholecystostomy and subsequently a cholecystenterostomy being done. This patient has also been shown at a meeting of this Society.

Perforated typhoid cholecystitis: In one of the cases, a male, during the third or fourth week of his attack of typhoid fever, had a sudden onset of acute abdominal pain, with distention. When I saw him, on the following day, he was comatose, and a rapid exploratory operation for suspected perforation of the bowel revealed two large holes in the gall-bladder, with profuse peritoneal soiling with purulent bile-stained material. The wound was rapidly drained and packed and the patient was returned to bed in eleven minutes, quite moribund. He was unconscious for seven weeks, but finally recovered.

In February, 1903, I presented the subject of primary typhoidal perforations of the gall-bladder at a meeting of this Society, recording the history of a female patient, forty-six years old, with a successful outcome. In my article at that time I recorded the then available statistics of this complication of typhoid, and found that, my own case included, there were 34 in all, and that of these, four had recovered.

Hydatids: Two patients with this complication have been operated on by me in the past two years. In one, where I did a

cholecystectomy and choledochostomy, the hydatid was about the size of a hen's egg. It was located in the liver at the sulcus of the suspensory ligament and was easily excised intact, with secondary suture of the liver. My second case of hydatids will be recorded under the fatal cases.

I have had one case of acute phthisis associated with cholecystitis gangrenosa. In this I did a successful cholecystectomy, but within less than one year jaundice occurred and colic recurred. A further operation was then deemed inadvisable. This was some three months ago, and I have not seen the patient since.

Hæmolytic jaundice: This patient was a young man of twenty upon whom I did a cholecystostomy for suspected cholecystitis, followed in six months by a splenectomy. The latter operation was done about three months ago with entirely satisfactory results.

A subphrenic abscess occurred in six of my series, with one death. This fatal case is the same one recorded under complicating hydatids.

Transduodenal operation: This operation has been done by me three times in my career, successfully in each instance. With the advent of the Blake forceps I feel the necessity of this procedure has been passed, as with the ordinary choledochostomy opening we can, with this instrument, grasp and remove with or without crushing all stones, even when well impacted in the papilla of Vater.

Morbidity and secondary operations: These questions cannot be reported definitely until some clearing house method is established of reporting to the original operator the patient's condition and the necessity for further operations, etc. When some such method is employed, data that is of value to all, particularly to the prospective patient, can be advanced.

Deaths: In 1910, out of a series of 43 of these cases, no deaths occurred.

In 1911 there were 54 operations, with four deaths. The first of these was a widow of fifty with general streptococcæmia. A cholecystostomy was done in the hope that some benefit might follow, particularly as the patient was slightly jaundiced. Death resulted from a septic endocarditis, the patient surviving the operation by several days. It is possible, indeed more than likely, that in this instance an unnecessary operation was done, but it is not probable that it hastened the patient's death.

The second death in the series was that of a Polish Jewess, well advanced in years and enormously fat, with double inguinal and an umbilical hernia, all of large size. She came under my

care with a general peritonitis, her illness dating back about ten days. A fairly clear gall-bladder history was obtained. Operation revealed a large perforation in the gall-bladder, with pus and bile free in the peritoneal cavity. This patient was apparently on the road to recovery when a fatal pneumonia supervened.

The third case was one of acute hemorrhagic pancreatitis in a man, fifty-five years old, with an illness of ten days' duration. He was moribund when a cholecystotomy was done and many stones removed. Death occurred within thirty-six hours.

The fourth case was that of a man over sixty, upon whom a choledochostomy and cholecystotomy were done. Death followed on the seventh day from embolism, while he was engaged in a fierce argument with his son, a physician, about the necessity of continuing his special nurses.

In 1912 there were 63 recorded operations, without a death. In 1913 there were 78 recorded operations, with 6 deaths, 2 of them after cholecystostomy.

The first case was that of a man, thirty-eight years old, who had dilated veins and varicosities to such a degree that merely rubbing the exposed mucous surface of the gall-bladder would be followed by a profuse hemorrhage. The veins in the vicinity of the pylorus and stomach were three-quarters of an inch in diameter. Death occurred on the fourth day, and was attributed to acute gastric dilatation.

The second case of this series was that of a man, fifty-five years old, with cardiac myositis, which proved fatal. In this case the operation showed a perforated gall-bladder, with a mural abscess containing air.

The third case was that of a woman of sixty where death followed a choledochostomy done erroneously for supposed duct obstruction which proved, upon microscopical examination of the autopsy specimens, to be a cell destruction by interstitial hepatitis. This patient had been operated on by me some three years before for a profound streptococcus cholangeitis. A cholecystectomy and choledochostomy were done, with a stormy convalescence and prolonged drainage, followed by a condition of health far better than she had enjoyed for fifteen years. After three years she had a sudden recurrence of her jaundice, and at the second operation the bile flowed perfectly clear and in fair quantity. While apparently progressing favorably, an acute nephritis supervened upon a chance renal impairment, with fatal result.

The fourth case was that of a man, fifty-five years old, with a suppurative cholecystitis, a pericystic abscess, empyema, and a suppurative hydatid cyst. This patient had suffered from jaun-

dice, with an intermittent temperature, for seventeen days, and was much emaciated. Operation revealed a perforated gall-bladder, with two well-localized abscesses, one on each side of the gall-bladder. Owing to the patient's serious condition, drainage only was done. Several days later, as the temperature still remained high, an exploratory aspiration of the chest was made and eight ounces of purulent fluid withdrawn. The following day a section of rib was made, and a few ounces of murky fluid evacuated. It was then seen that what had been regarded as a typical empyema was a lesion involving the dome of the liver, and, upon puncture, over a quart of hydatids in most foul colon communis pus was evacuated. Death followed from exhaustion about two weeks after the operation.

The fifth and sixth cases, one a man fifty-five years old, and the other a woman of seventy-four, both died of nephritis, the first after a cholecystectomy and the second after a cholecystostomy.

In 1914, up to April 10, there is a series of 26 cases, with 3 deaths. The first was that of a woman with well-advanced symptoms who died from nephritis after a cholecystectomy. The other two patients were males, aged fifty-five and fifty-seven years, respectively. The first was much emaciated and deeply jaundiced, with skin the color of mahogany. A choledochostomy was done and the patient died four days later from an embolism. The second patient had already been operated on for prostatic enlargement and his urine contained the bacillus coli communis. There was an intermittent temperature of the Charcot type. A cholecystectomy and choledochostomy were done, showing evidence of a pure streptococcus infection. The patient's temperature dropped from 103.6° to 99°, he developed a generalized maculopapular eruption (septic infarcts) and died on the eighth day.

With the citation of the fatal cases, as given above, I cannot feel that I have been responsible for a single death by doing any additional operative procedure, as it will be observed that of the thirteen deaths, but two of these patients had any complicating disease. The fourth death in 1911 was the result of pancreatitis, and was reported as such in a paper on pancreatitis published during the present year in the *New York Medical Journal.* The other, the fourth case that died in 1912, required the operations to which he was subjected, excepting the one for supposed empyema, as I am satisfied that my exploring needle must have tapped his hydatid abscess. Nevertheless, the suppurating hydatids were best approached through the transpleural route.

As a conclusion based upon these statistics, I am inclined to perform cholecystectomy more frequently than heretofore.

RETENTION CYSTS OF THE PANCREAS*

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The patient, a male aged fifty-nine, was admitted to the University Hospital complaining of pain in the upper abdominal region. He states that he noted a feeling of discomfort in the epigastrium six years ago, and at times suffered from pain which radiated from the epigastrium to the lower dorsal region. Coincident with the discomfort, he experienced a sensation of pulsation in the upper portion of the abdomen, and several months ago was able to palpate a mass in the midline above the umbilicus, in the situation where the pulsation was present. The mass would disappear for a time, then reappear, and of late has been present only in the standing posture. He has lost about six pounds in weight and has had several attacks of jaundice.

The patient is married, a laborer by occupation, does not use alcohol or tobacco, his appetite has always been good, there has been no discomfort after eating.

The physical examination shows in the epigastrium a pulsating mass which seems to blend with the abdominal aorta. There is no tenderness or rigidity.

Gastric analysis: Free HCl, 0; total acidity, 20; trace of lactic acid; occult blood, 0. The microscopic examination shows much mucus, starch granules and a few Oppler-Boas bacilli.

Urine examination was negative.

Blood: Hæmoglobin, 60; red blood-cells, 3,800,000; white blood-cells, 9900.

Operation (by Dr. Frazier).—A right rectus incision was made and on examination the stomach, duodenum and gall-bladder were found to be normal. In the folds of the gastrohepatic omentum a cystic tumor was found, the contour was irregular and the mass was about the size of a large peach. On the posterior aspect it seemed to be in relation with the vena cava and adherent to the head of the pancreas, so that in removing it a thin layer of pancreatic tissue was carried away with the tumor. The rent left in the gastrohepatic omentum was closed with a purse-string suture, leaving a small opening for a drainage tube.

The patient made an uninterrupted recovery and was discharged cured.

* Read before the Philadelphia Academy of Surgery, May 4, 1914.

Pathological Examination.—Specimen consists of an irregular nodular mass which measures 4.5 x 6 x 4 cm. and weighs 85 gms. The external surface contains numerous cysts and has adherent to it portions of a thin, fatty membrane resembling omentum. Between the cystic areas the tissue is dense and contains numerous points resembling cartilage. On cross-section the specimen is seen to be riddled with cysts, the largest of which measures 2 cm. in diameter, the lining is smooth, and the contents consist of a cloudy fluid. In the centre of the tumor, and surrounded by the multiple cysts, is a dense mass of whitish tissue which has the consistency of cartilage and contains several points of calcification.

Microscopic examination of sections removed from the wall of the larger cysts shows a pronounced fibrous overgrowth which surrounds and distorts the pancreatic tissues present. In some instances the acini are well preserved, but for the most part the fibrous stroma has altered the outline of the lobules to a marked extent. The individual acini and ducts are surrounded and separated by the fibrous overgrowth which has isolated small groups of acini. Islands of Langerhans are present, many of them appear normal and others are infiltrated with red blood-cells. The stroma for the most part is rich in cells but in some places it has undergone hyaline degeneration and contains few cells. With the exception of these areas it is well vascularized, the vessels having been recently formed and most of them are congested. In the centre of the specimen the glandular tissue practically disappears, the tissue has a hyaline-like appearance and contains many points of calcification. In the areas in which the fibrous overgrowth is most intense, many of the acini show slight degrees of dilatation. The cysts are lined with epithelium which is cuboidal in shape in the small cysts and flat in the larger ones. The epithelial lining is composed of a single layer in many cysts, in others it is heaped up and in many of the larger ones the lining is entirely absent. The contents of the smaller cysts is composed of blood, and traces of blood-pigment are found in the fibrous stroma.

The fluid in the cysts is slightly acid, and microscopically contains debris, many erythrocytes and a few epithelial cells. The examination for ferments was not made, as the specimen was fixed in formalin soon after removal.

The gross features and the microscopic study of the specimen indicate that the cysts belong to the retention variety, and that the chronic pancreatitis is to be held responsible for the process. The history of repeated attacks of jaundice indicates that the pancreatitis may have originated in infection from the biliary passages. The presence of calcification in the cyst wall has been mentioned in the reports of other cases but is usually associated with the pseudocysts of traumatic origin.

Pancreatic cysts may be divided into four main groups: The proliferation cysts (adenocystoma), degeneration cysts, pseudocysts, and retention cysts.

The proliferation cysts are to be regarded as new formations, and are not common, as Kleinschmidt in 1907 collected 21 cases from the

FIG. 1.—Retention cysts of the pancreas.

literature. Lazarus states that the adenocystoma is the most common form of cyst, and believes that many cases are not recognized because, in the surgical treatment, the cyst is merely drained, and its true nature not appreciated. This statement is disputed by other writers, the majority of whom regard the traumatic pseudocyst as the most common form.

The epithelial and connective-tissue proliferation in the adenocystoma results in the formation of papillary projections into the cyst, the condition resembling greatly the cystoma of the ovary. When epithelial proliferation is demonstrable, the differentiation between the adenocystoma and other cysts is not difficult; but when the epithelial lining disappears, the differentiation becomes impossible in some cases. As a rule, however, the epithelium persists in the smaller and more recently formed cysts, although it has totally disappeared in the larger ones. The destruction of epithelium is probably due to pressure atrophy, as it seems unlikely that the pancreatic secretion would destroy epithelium and have no action on the surrounding connective tissue (Korte). Trypsin has never been found in the cyst contents, although in a few instances ferments reducing sugar and fat have been isolated.

The adenocystoma are most commonly found in the tail of the pancreas. In Kleinschmidt's 21 cases, 2 arose in the mid portion; in 4 the cyst involved the entire gland, and in the remaining the tail was the seat of the growth. The tumor is attached to the pancreas by a broad base, is rarely pedunculated, and is always surrounded by a firm, fibrous capsule which separates it from the pancreas.

The pancreas in a small number of cases is the seat of chronic inflammation; this is regarded by Lazarus as an important etiological factor, for conditions favoring stasis of secretion play a rôle in the origin of adenocystoma. It should be mentioned that stasis is more prone to occur in the tail of the pancreas where the proliferating tumors have their site of predilection. Chronic inflammation is rarely general and is limited to the parenchyma about the tumor. As the tumor is located in the tail of the pancreas almost exclusively, the remaining portion of the gland usually is free from disease and its function is undisturbed. The chronic pancreatitis associated with retention cysts, on the other hand, is diffuse in nature, involves much pancreatic tissue, interferes greatly with its function, and leads ultimately to severe disturbances in secretion and metabolism. We find, therefore, that adenocystoma is rarely accompanied by evidence of wasting or weakness, and that retention and other forms of cyst are prone to produce such symptoms.

In the differential diagnosis between adenocystoma and other forms of pancreatic cysts, Kleinschmidt calls attention to the following points:

The majority of adenocystoma occur in females, whereas both sexes are equally affected by the other cysts. The cystomata develop slowly, are progressive, produce no symptoms, there is no history of traumatism. A history of traumatism is elicited in 30 per cent. of the other cases. In these digestive disturbances are common, the course is rapid, there may be intermittent enlargement or actual temporary disappearance of the tumor. The subjective symptoms differ greatly, being absent or slight in the cystoma, they are characterized by severe pain, loss of appetite, vertigo, constipation or diarrhœa in other forms. The general condition of the patient depends on the amount of pancreatic tissue involved by the cyst. There is little or no systemic disturbance in the cystomata, as the growth generally is confined to the tail of the gland. The traumatic and other cysts, however, usually are accompanied by loss of weight, strength and severe anæmia.

The prognosis is always grave. The development in some cases has been so slow that the tumor produced no symptoms, and was only discovered by accident. When the tumor begins to grow rapidly the danger of pressure on important surrounding structures and organs is great. When of large size and the pancreas is involved to a marked extent, alterations in nutrition arise and hasten a fatal outcome. Malignant degeneration is always to be feared.

The degeneration cysts are secondary to various inflammatory and neoplastic processes in the pancreas. Lazarus has found that toxic processes and various infectious diseases, as well as the softening of malignant tumors, are instrumental in producing this form of cyst. Autodigestion of effusions, especially when followed by indurative lesions about the hemorrhage, are responsible for the production of degeneration cysts of traumatic origin.

Injuries to the pancreas followed by hemorrhage can cause four different lesions according to Lazarus:

(1) Indurative pancreatitis, which possibly can lead to formation of true retention cysts.

(2) "Endopancreatic pseudocyst," the formation of which is the result of autopeptic and inflammatory processes.

(3) Degenerative cysts following fat necrosis.

(4) Hæmatoma of the pancreas and omental bursa (peripancreatic pseudocyst).

Pseudocysts are formed from hemorrhagic effusions into the tissues surrounding the pancreas, and almost always follow traumatism and inflammation of the gland. In rare instances autodigestion of encapsulated hæmatomas in the substance of the pancreas may be followed by

cyst formation. Rupture of the peritoneal covering of the pancreas permits both blood and pancreatic ferments to escape into the omental bursa. The reactive inflammation causes connective-tissue proliferation and condensation, a cyst wall is thus formed. When the pancreas is torn, the cyst may connect directly with the necrotic and degenerated gland tissue. The cyst does not contain an epithelial lining, a fact of importance in differentiating pseudocysts from adenocystoma and retention cysts. It should always be borne in mind, however, that the epithelium may have been destroyed by the action of pancreatic ferments. The cyst contents is variable, although traces of blood can generally be found, either in the cyst contents or in the wall. In many cases the fluid is clear, due to absorption of the blood, although cysts of long standing may have bloody contents due to erosion of the vessels, and consequent fresh hemorrhage. There is little doubt that repeated hemorrhages into the cyst are responsible for its enlargement.

A history of traumatism has been elicited in about 25 to 30 per cent. of the cases. Gobell, in 230 cysts which were operated upon, found that a history of traumatism was present 76 times. The symptoms appear in the majority of cases soon after the injury and are accompanied by severe pain and other symptoms indicating disturbance of digestion.

Retention cysts arise either from the duct of Wirsung or from the smaller ducts and acini. The obstruction of the duct is due to pressure, pancreatic calculi, stricture, etc., and is followed by stasis and dilatation, the cystic condition gradually extending to the main branches of the duct. When the process begins in the small ducts or acini, obstruction to the outflow of secretion results in stasis and dilatation. The cause of the obstruction, according to the histologic researches of Tilger, Dieckhoff and others, lies in a preceding chronic pancreatitis. The connective-tissue proliferation accompanying this process surrounds and compresses the pancreatic glands and ducts. The stagnant secretion causes fatty degeneration of the gland cells, the ferments next act upon the pathologically changed wall, the membrana propria disappears by autodigestion, the interstitial tissues undergo necrosis, and by confluence of many acini a small cyst is formed.

The importance of chronic pancreatitis as an etiological factor in the production of retention cysts is recognized by most writers, the majority of whom regard the process as primary. Lazarus endeavored to prove experimentally whether mechanical injuries by inducing interstitial inflammation caused cyst formation. The pancreas was injured by direct trauma, vessel ligation or by the injection of irritating fluids. The resulting connective-tissue proliferation, especially involving the inter-

stitial tissues, caused compression of, and injury to, the acini, adhesions between the capsule and parenchyma, hyperplasia of the periductal tissues, and an active increase in the number of ducts. As a result of this cirrhotic process, the ducts were cut off and dilatation resulted. By producing subcapsular hemorrhage from trauma, and the injection of small amounts of iodine into the exudate, a reactive pancreatitis was induced and a cyst without lining, the size of a goose-egg, resulted. When a pancreatitis was not induced by iodine injection, the hæmatoma was absorbed and a scar resulted.

The formation of such pseudocysts is aided by the artificial production of pancreatic cirrhosis which favors stasis of secretion in the surrounding tissues. Following traumatism, therefore, pancreatic secretion escapes from the acini; the hæmatoma, the surrounding parenchyma and tissue shreds are digested. In the periphery a reactive inflammation leads to the formation of a capsule and further absorption is retarded by the chronic induration.

Lazarus gives the name of " intrapancreatic pseudocyst " to formations of this kind, the traumatism and cirrhosis being the important factors. Tilger and Dieckhoff believe, however, that hemorrhage into the parenchyma never causes cyst formation, and that when traces of blood can be demonstrated, the hemorrhage is to be regarded as secondary.

Honigmann states that endopancreatic cysts can arise in two ways: through cystic transformation of hæmatoma arising in the gland parenchyma, or upon the basis of a chronic interstitial pancreatitis. In the first case the pancreatic ferments induce degeneration of the blood and tissues, and the cyst may reach great size if the normal resorptive ability of the pancreas is retarded. The experiments of Lazarus show that the reactive inflammatory processes in the surrounding tissues have a marked tendency to retard absorption. This form of cyst, as in the more common peripancreatic pseudocysts, occurs a short time after the injury is inflicted, and differs greatly from the chronic course pursued by the cysts secondary to chronic indurating lesions.

The chronic pancreatitis present in many of the cases reported has been secondary to systemic infections, such as syphilis, toxæmias, etc., or to local infection most commonly arising from the biliary passages. Honigmann points to the possibility of traumatism as a factor in producing chronic pancreatitis. The healing of many small foci of hemorrhage, with scar formation, and connective-tissue proliferation may directly cause sufficient contraction of tissues to cause stasis of secretion and dilatation, and thus produce retention cysts.

It seems feasible from these views to conclude that true retention

cysts in the majority of cases are due to a preëxisting chronic pancreatitis. In most of the cases the pancreatitis follows some general infection, but, in rare instances, traumatism may invoke a local reaction which in turn leads on to the cyst formation.

The author desires to thank Dr. C. H. Frazier for permission to record this case.

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CYSTIC LYMPHANGIOMA OF THE GREAT OMENTUM*

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The question of cyst formation in the great omentum has been discussed to a certain extent in the literature, some 50 or more individual case reports, so far as I have been able to ascertain, having appeared to date, notwithstanding which the subject seems to be but very imperfectly understood; there are great differences of opinion with regard to the origin and significance of such cysts, and indeed comparatively few of the reported cases have been studied with sufficient care to permit of a definite determination of their point of origin and mode of formation. That the condition must be a distinct rarity is shown by the fact that only this half hundred so-called cases of omental cysts are available for study—and a number of these must on careful analysis be discarded—but it presents, nevertheless, several points of interest from both the pathological and clinical aspect.

My interest in the subject has been aroused by a case which came under my observation some months ago. The patient was a colored woman, thirty-four years of age, who was admitted May 5, 1913, to the Gynecean Hospital, service of Dr. H. D. Beyea, for the removal of a large tumor, which had been causing a noticeable increase in the size of her abdomen for about eight years. On examination, a hard nodular mass could be felt, extending well above the umbilicus; a diagnosis of uterine myoma was made, and was found upon opening the abdomen to be correct, the uterus itself being somewhat enlarged and multinodular, and having attached to its fundus an almost pedunculated tumor about the size of a man's head. There were numerous intestinal adhesions, and closely attached to the upper portion of the large tumor was the great omentum, which presented the remarkable cystic condition described below. The uterus, both tubes, and right ovary were removed, as was the great omentum, after ligation of the vessels close to the transverse colon. The left ovary and appendix appeared normal, and were not removed. The patient made an uneventful recovery.

Specimen.—The uterus proper measures 9.5 x 8 x 8 cm.; its surface is covered by extensive fibrous adhesions, and on section its walls are seen to contain numerous intramural nodules, varying in size up to 3 cm. in diameter. The

* Read before the Philadelphia Academy of Surgery, May 4, 1914.

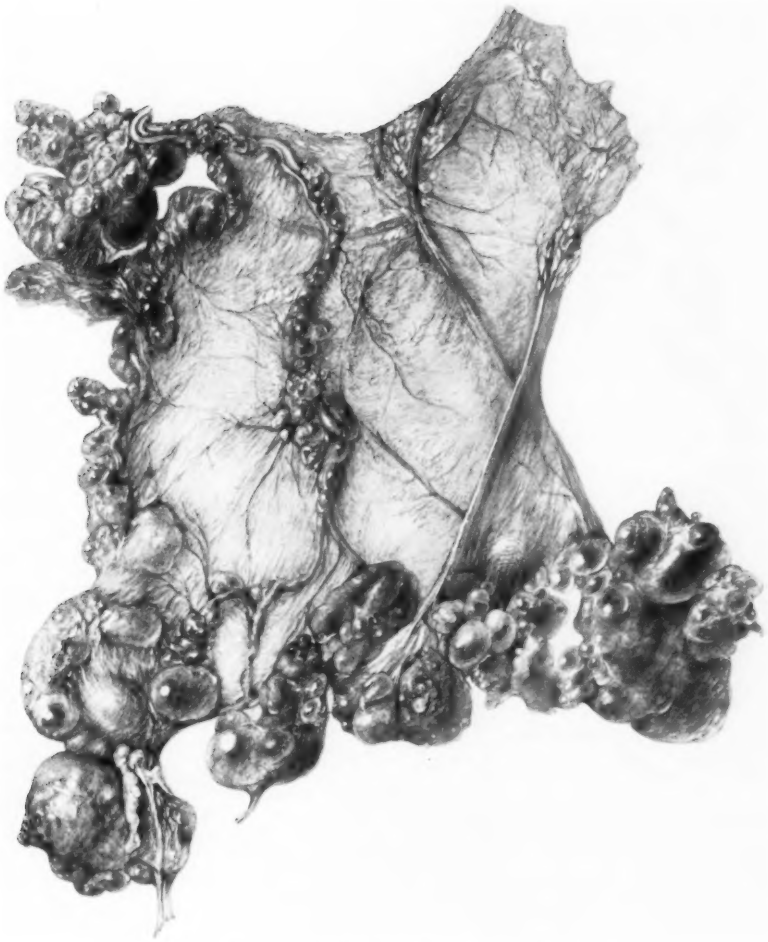

FIG. 1.—Macroscopic drawing of omentum with cysts.

FIG. 2.—Section through wall of one of the larger cysts.

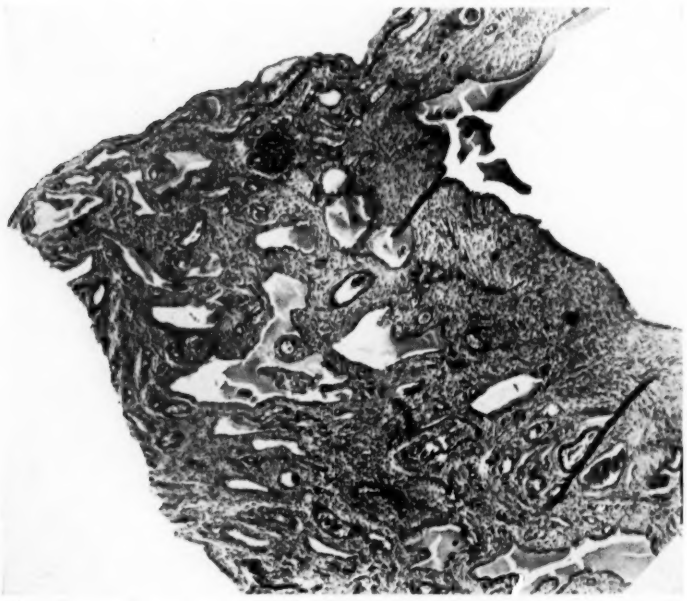

FIG. 3.—Wall of one of the larger cysts, showing numerous lymph spaces of various sizes, lined with endothelial cells.

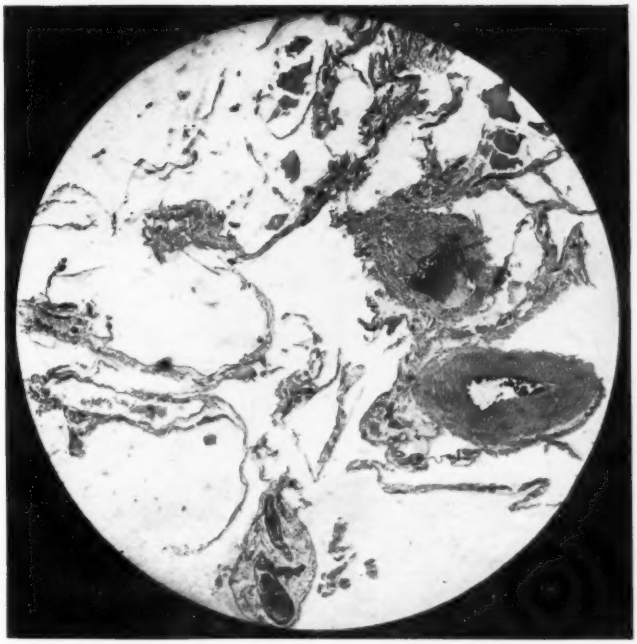

FIG. 4.—Section through the blood-vessels seen traversing the central portion of the omentum in Fig. 1, showing a cross-section of the artery and vein, surrounded by numerous thin-walled, cystic cavities. Very low magnification.

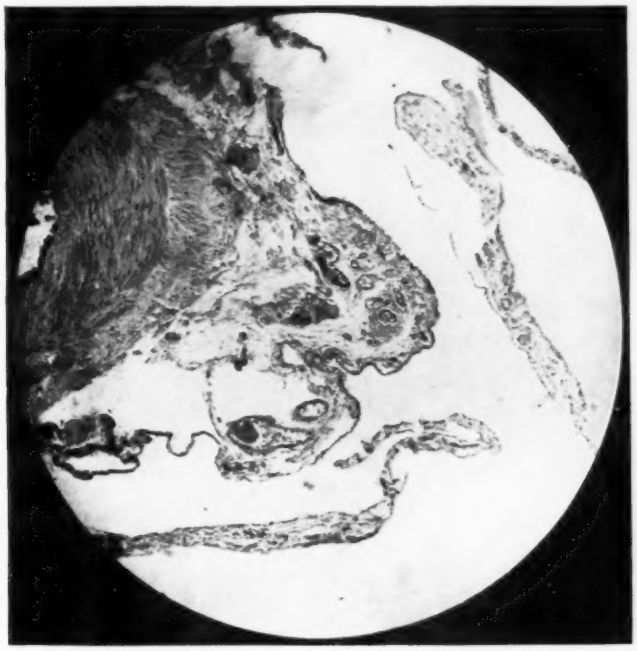

FIG. 5.—Higher power photograph of a portion of Fig. 4, showing the wall of the artery, and surrounding cystic cavities. These are lined by a distinct layer of flat cells with deeply staining nuclei.

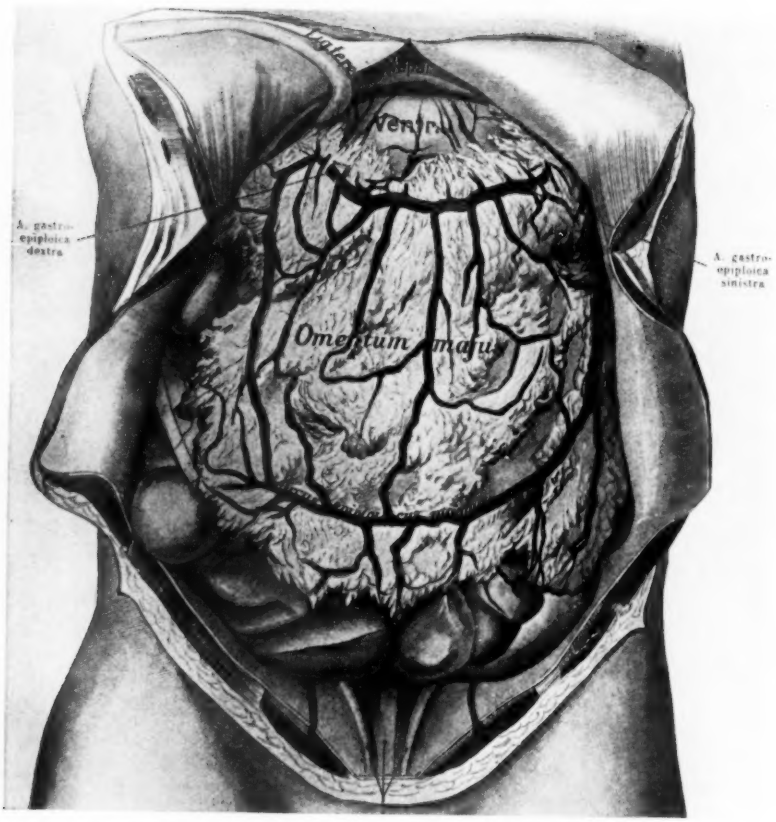

FIG. 6.—Blood-vessels of the great omentum (after Broesike).

large tumor is roughly kidney-shaped; it measures 22 x 16 x 16 cm. Its surface is likewise covered in places by adhesions, and at one point it shows a roughened area about 4 cm. in diameter where it was attached to the fundus of the uterus. Microscopically, all the tumors show the characteristic appearance of myomata. Each tube has been transformed into a small hydrosalpinx; the right ovary contains a small corpus luteum cyst, but is otherwise normal, save for numerous adhesions on the surface.

By far the chief interest of the specimen centres in the *great omentum* (Fig. 1). This is a roughly quadrilateral sheet, measuring 20 x 18 cm. The central portion is thin and delicate, presenting the appearance of normal omental tissue, with very little fat. Around the entire circumference, however, are closely grouped masses of thin-walled cysts, which, when they first presented in the abdominal wound, resembled nothing so much as clusters of grapes. When the omentum had been fully exposed, however, it almost appeared as though a somewhat atypical segment of colon were attached completely around its free border, this appearance being furnished by the continuous masses of cystic bodies on the periphery. The cysts vary in size up to several centimetres in diameter, but on account of their extensive confluence it is not always easy to determine the exact size of any particular individual or group. The external surface of the cysts is for the most part smooth and glistening, the walls are thin and delicate, the contents clear, watery fluid. In addition to the larger cyst masses, which are limited exclusively to the periphery of the omentum, strings of much smaller ones are seen closely hugging one or two of the larger blood-vessels as they cross the central portion.

Microscopic sections through the cyst walls show these to be composed of rather loose connective tissue, containing numerous much engorged capillary blood-vessels, and a fairly intense and widely disseminated infiltration of small round cells. No fat is to be seen. Separating this connective tissue stroma from the cyst cavities is seen in every instance a single layer of flat cells, with distinctly staining nuclei, very strongly suggestive of the endothelium lining lymphatic channels (Figs. 2 and 3). These are present in the largest as well as in the smallest, and in all intermediate-sized cysts; in many places the thicker septa between the larger cavities contain numerous small, endothelial-lined spaces which almost certainly represent merely somewhat dilated lymph capillaries (Fig. 3), and since there is a continuous gradation between these and the largest of the cysts, the assumption seems strongly justified that the entire process has had its origin in a cystic dilatation of the lymphatic channels of the omentum, due to causes which will be discussed later. Still further evidence in favor of this etiology is furnished by examination of a cross-section through the blood-vessels with small surrounding cysts seen traversing the central portion of the specimen (Figs. 4 and 5). In this section we see an artery and vein, surrounded by a very small amount of loose areolar tissue, and then by a conglomerate of delicate-walled cystic cavities, each lined by the type of cells described above. From their structure and arrangement there can be practically no other interpretation of these spaces than that they represent much dilated perivascular lymph-channels. In most of the larger cyst cavities is seen a small amount of homogeneous material, which in eosin-hæmatoxylon preparations takes a diffuse pinkish stain.

The question naturally arises, as to whether the occurrence of this marked degree of cyst formation about the periphery of the omentum, the remainder of the organ being but slightly involved, and then only along the course of a main blood-vessel, can be in any way explained by the anatomical arrangement of the lymphatics. A careful search through more than a dozen of the more important works on anatomy [1] has failed, however, to bring to light a single description of the arrangement of the lymphatic vessels of the great omentum, nor does its blood-vascular system receive, in many instances, much better treatment. Many of the authors dismiss it with the bare statement that the gastro-epiploics give off descending branches which pass down into the omentum, what happens to them after they get there being left to the reader's imagination; in some instances, however, the statement is made that the descending branches pass down through the anterior layer of the omentum to the free border, and then turn upward in the posterior layer, to anastomose with vessels coming from the transverse colon. Likewise, in most of the drawings illustrating the vascular supply of this region of the body, the lower portion of the omentum is left out entirely, or if it is included, its vessels are represented merely as a few trunks, running straight downward, and after a few subdivisions, ending as terminal branches near the free border.

Norris, however, who has made a careful study of the finer structure of the omentum, goes into the matter somewhat more in detail. He says, "In some cases there are four main arteries which come down laterally on the sides of the omentum, two on the anterior and two on the posterior surface. More frequently, however, the organ is supplied by a central artery in the anterior, and a corresponding artery in the posterior leaflet. As a general rule, three distinct branches are given off from these vessels, which run transversely across the surface of the omentum. They are about an equal distance apart, the lowermost branch corresponding to nearly the lowermost portion of the omentum. . . . The arteries are accompanied by veins." The only drawing I have been able to find that brings out in any way this formation of a transverse vascular arc near the free border is one in Broesike's Anatomic Atlas, showing a distinct arcuate anastomosis between the vertically coursing blood-vessels just within the free border of the omentum (Fig. 6). Although this vascular arrangement is undoubtedly of very

[1] Including Gray, Holden, Piersol, Cunningham, Morris, Gerrish, Quain, Deaver, Sobotta-McMurrich, Toldt, Rauber-Kopsch, Spalteholtz, Testut, Poirier-Charpey, and Sappey.

irregular, and probably infrequent occurrence, it is of much interest in connection with the subject under discussion, for if we may assume, as seems reasonable, and as Norris specifically states, that in the omentum "in a general way, the chief lymph-channels follow the larger blood-vessels"—a condition which certainly holds in the remainder of the gastro-intestinal tract, and in many other portions of the body—may not this anatomical condition explain the production of the more or less continuous chain of cystic structures, evidently of lympho-vascular origin, around the entire edge of the great omentum? If a considerable lymphatic trunk accompanies a vertical artery on each edge of the omentum, and also this "arcus epiploicus magnus," as Broesike calls it, any factor that would lead to its cystic dilatation would produce exactly the conditions described. This factor may well have been, in the present instance, furnished by the inflammatory condition which had at some time existed throughout the lower abdomen and pelvis, as is evidenced by the extensive adhesions and by the round-cell infiltration in the cyst walls. Especially does it seem plausible that the adherence of practically the entire free border of the omentum to the large uterine tumor may well have interfered with the circulation in lymphatic trunks along the vascular arch mentioned above, causing thus mechanically their cystic dilatation, the active inflammatory process acting in addition as a stimulus to proliferation of the endothelial elements, and thus resulting in the production of a true lymphangioma. The much less marked, but still distinctly evident, involvement of the lymphatics accompanying the central vessel in its vertical course would be explained by the less active inflammatory process, and absence of adhesions, in this portion of the omentum.

A certain amount of support to this hypothesis would seem to be furnished by one case, reported by Gairdner in 1851, in which almost identical conditions were present, and resulted in the production of very similar cystic formations in the omentum, this being the earliest instance of omental cysts on record. The patient was a woman who had a large fibroid tumor of the uterus. At autopsy there was found beneath the anterior layer of the great omentum a cystic structure consisting "of a highly transparent closed sac, between 3 and 4 feet in length, and from ½ to 1½ inches in breadth, having a lobulated appearance externally like that of the distended colon, but in no part subdivided by any approach to complete septa. The fluid in the sac was a transparent colorless serum, containing numerous flocculi." An interesting feature of this case was that there were indications of a tendency to cyst formation in other parts of the body also, small globular cysts

being found in the cellular tissue of both groins, in the velum interpositum, and in the pineal gland.

Another case of some interest in this connection has been reported recently by Stillman. His patient was a woman of forty-two, whose abdomen had been increasing in size for about five years; at operation a pedunculated fibroid tumor the size of a man's head was found attached to the uterus, and also to the omentum by a vascular pedicle as thick as the thumb. "Distributed throughout the omentum were numerous elongated, tortuous, exceedingly thin-walled cysts, from 1½ to 2 inches in diameter, showing a characteristic lobulation or sacculation comparable to that of the distended colon. The gastrocolic omentum was also affected, but to a much less extent, the dilatations here being much fewer and none larger than a lead pencil; they were unmistakably dilated and tortuous lymph-vessels." A second, strikingly similar case, reported by Fitz in an unpublished Lane lecture (San Francisco, 1910), is also referred to by Stillman. "It was a case of enormously dilated lymphatics of the omentum, occurring in a woman who also had a fibroid of the uterus, to which the omentum was attached. The omentum was reduced to a web of connective tissue supporting the tremendously dilated lymphatics."

It is not my purpose here to review in detail the literature upon omental cyst formation in general, since this has been done more or less extensively by practically every recent writer upon the subject. In 1911 Dowd was able to collect 37 cases which had been reported up to that time as cysts of the omentum, and his tabulation has formed the basis of most subsequent articles in this country, while in the German literature it has been taken over practically intact by Monnier, who in a recent extensive monograph has added 5 more, bringing the total (including Dowd's own case) up to 43. In addition, however, cases have also been described under the general designation of omental cysts by Frank, Giannettasio, Lipscher, Markoe and McPherson (3 cases), Thornton (2 cases), Buckley, Funk, and others, bringing the total number of instances known in which some form of cystic process has occurred in the omentum up to something over 50. The exact number is of little moment, however, and would be practically impossible of determination, for many of the descriptions are so meagre, and so lacking in essential details, that the cases to which they refer cannot be definitely classified. Moreover, even the most cursory perusal of these reports shows that they cover a distinctly heterogeneous group of pathological processes, many of which have practically nothing in common other than their anatomic situation in relation with the omentum.

Leaving aside entirely the group of cystic formations due to hydatid disease—which is not included in the above-mentioned tabula-

tions, although it occasionally involves the omentum in conjunction with other abdominal viscera—we find that some of the so-called cysts represent nothing but secondary degenerations of malignant tumors (Hasbrouk) or hematomas (Dowd, Simon), or sacculated collections of fluid following traumatic rupture of an abdominal viscus (Cotman). Others were only parasitic with regard to the omentum, having apparently arisen primarily in some other organ, such as the ovary (Waldy), and others, again, were merely secondary implantations in the omentum from malignant ovarian growths (Thornton). In one unique instance, the origin was probably due to a mycotic infection which had penetrated the walls of the intestinal tract (Ris).

For these various reasons, therefore, quite a number of the reported cases must be rejected from a discussion of cyst formation proper in the great omentum. Those that remain, and which may be considered *true cysts,* in that they represent, as far as can be determined, the result of actual proliferative or secretory processes, have for the most part presented clinically one of two chief types, although the dividing line is by no means a sharp one, and some cases occupy a distinctly borderline position. In some instances the omental tumor consisted of a single or but few loculi, was large and prominent, and was itself the cause of the patient's seeking surgical attention; in others, the cysts were small, multitudinous, and were scattered throughout the omentum, or chiefly about its periphery, as in the present specimen. In this type, the discovery of the omental condition has usually been incidental at operation or autopsy, no suspicion of its existence having arisen clinically. In the former type of tumor, however, the distention of the abdomen has often reached enormous dimensions, as in the one reported before this society a few years ago by Rodman. These cysts have developed at all ages, from earliest infancy to adult life; when occurring in infants and children, the preoperative diagnosis has almost universally been tuberculous peritonitis; when occurring in adults, either this, or in female subjects, ovarian cyst. Under these mistaken diagnoses repeated tappings have been performed in a number of instances, but re-formation has invariably followed, eventually necessitating radical extirpation.

While a number of authors consider many of these larger as well as the smaller cysts of lymphatic origin, and, indeed, Jacoby maintains that all true omental cysts are of this etiology, a number of other explanations have been offered to account for them. Owing to their frequent occurrence in infants and young children, a congenital origin from embryonic rests between the layers of the omentum has been strongly advocated by some investigators. Of several cases so diag-

nosed, the one in which this explanation appears the most plausible is that reported by Henke, in which at autopsy numerous small cysts were found scattered throughout the omentum, and also pretty generally throughout the visceral peritoneum of the abdomen. These cysts contained a seromucinous fluid, showed the presence of numerous smooth muscle bundles in their walls, and were lined by a layer of cuboidal to tall cylindrical epithelium.

Another hypothesis that has been offered is that the cysts arise from the flat cells covering the serous coat of the omentum (Seefisch, Himmelheber, Karas), and represent therefore practically nothing more than loculated collections of peritoneal fluid. That cyst formation from the surface-serosa does occur in many of the abdominal and pelvic organs, especially the tubes and ovaries, is of course well known, the inflammatory factor here probably playing an important rôle. Karas, whose case quite closely resembles in some respects the one reported in this paper, makes a great deal of the fact that the cysts were lined with epithelial-like cells, many of which apparently showed in places the presence of *cilia,* structures which certain authors claim to have demonstrated as a normal constituent of the lining cells of the peritoneum. From this fact, Karas concludes that the cysts in his case were of peritoneal origin; he thinks, however, that this cyst formation on the part of the peritoneum was the result of some abnormality in the embryonic development of the omentum, since he could not find anything to suggest a post-embryonal occurrence, such as inflammation, notwithstanding the fact that a marked round cell infiltration was present in the cyst walls.

At first sight, this theory of origin was the one which most strongly suggested itself as the explanation for the occurrence of the cysts in the present instance, until more careful examination of the specimen led to the different conclusions stated above. To sum up, therefore, it may be said that while the possibility of the origin of some cases of true cysts of the omentum from embryonal rests, or from the surface peritoneum, cannot be positively denied, it may be considered demonstrated beyond any reasonable doubt that in other instances the lymph-vessels are the starting point for such growths, and this latter explanation would certainly appear to be the one which would apply in the majority of cases.

With regard to the diagnosis of omental cysts, there is not a great deal to be said. In view of the rarity of the condition and the lack of any distinctive symptoms, it is not strange that in only two or three of the reported cases has even a tentative diagnosis been made before

opening the abdomen. Brandt claims to have diagnosed a large cyst of the omentum " by exclusion," and in one of Stillman's cases a preoperative diagnosis of " either an omental cyst or an ovarian cyst with a very long pedicle " was made. The presence of a distinctly sacculated collection of fluid, not associated in any way with the genital organs, might, in the absence of any symptoms suggestive of a tuberculous condition, lead to the suspicion of omental cyst; beyond this, however, it is hardly possible to go with our present diagnostic resources.

The only rational treatment for the condition is extirpation of the cyst-bearing portion of the omentum. Tapping is of course, as has been stated, not only ineffectual, but may give rise to hemorrhages and adhesions, which markedly increase the difficulty of subsequent operation. It is possible that in a very occasional case drainage and marsupialization might be necessary, but with the present development of surgical technique, and in view of the excellent results which have followed the more radical type of operation in most of the reported cases, instances in which any other procedure would be indicated must be considered decidedly the exception.

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PRIAPISM

REPORT OF CASES AND A CLINICAL STUDY OF THE LITERATURE WITH REFERENCE TO ITS PATHOGENESIS AND SURGICAL TREATMENT

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True priapism is a remarkable pathologic condition of prolonged and persistent erection unaccompanied with sexual desire, and usually painful. It is to be distinguished from the transitory nocturnal forms of recurrent erection, which are not uncommon in inflammatory conditions of the genito-urinary tract, and which are usually of slight significance and amenable to local treatment. True priapism, as a rule, responds to no form of medication, and subsides spontaneously, sometimes quickly, but usually very gradually. Its pathogenicity is varied and obscure. The condition is rare, there being only about 170 cases reported in the whole medical literature. The object of this paper is to report two new cases and to indicate, through an analysis of cases in the literature, a simple classification and a rational course of treatment.

Case I.—W. L., a colored man of forty-five, stevedore by occupation, came to the Johns Hopkins Dispensary, Friday morning, April 14, 1913, complaining of having had an erection since 5 o'clock that morning.

At the age of 30 he had a chancre for which he took treatment for six months. He gives no history of secondaries. Married 22 years and has two healthy children. Family and personal histories are otherwise negative. Patient says that he and his wife had intercourse this morning at about 4 o'clock. After the act, which was normal, he did not feel satisfied and desired a second which his wife refused, and on this refusal he lays the blame of his present condition. He soon ceased to have sexual desire but the penis remained erect and began to ache. On physical examination there is found a pronounced arcus senilis in both eyes, enlargement of the axillary inguinal and epitrochlear glands, tortuous and thickened radials. The deep and superficial reflexes are all normal and a careful neurological examination by Dr. Taneyhill was negative. Neither the spleen nor liver are palpable. Blood-pressure is 165 mm. (Tycos). Blood ex-

amination showed 7000 white blood-cells and 80 per cent. hæmoglobin (Sahli). The urine in three glasses is clear in all. It has a specific gravity of 1006, shows a small cloud of albumen but nothing microscopically. Guaiac and acetone tests are both negative. The phenosulphonephthalein test gives an output of 48 per cent. after one hour and ten minutes by intramuscular injection. Blood taken for Wassermann.

Special Note.—The penis is in a condition of extreme erection, slightly bowed down and to the right. Movement in any direction causes considerable pain. There is no urethral discharge. The corpora cavernosa are tensely distended and hard, while in marked contrast the corpus spongiosum is flaccid and soft and the glans penis is small and compressible. At the root of the penis the two ischiocavernosus muscles are felt to be rigidly contracted in a rope-like cramp, and are tender. On the dorsum of the penis can be seen the scar of an old chancre. The scrotum and its contents are negative. The prostate is normal in size, shows no tenderness or nodules, and its secretion is negative. Both seminal vesicles are palpable, but normal.

The patient was admitted to the colored ward. The galvanic electric current was applied to the contracted ischiocavernosus muscles with no effect. Patient put to bed. Ice caps applied to the penis and perineum. Morphine gr. ¼ (h.) given every three hours.

April 15: No improvement.

April 16: No improvement. Patient drowsy and asleep most of the time, but there is no change in the local condition even during deep sleep.

Report of Wasserman reaction, positive.

April 17: Morphine discontinued; 0.9 mg. neosalvarsan given intravenously, and the patient put on a mixture of potassium iodide and bichloride of mercury (grs. 5 and 1/17 respectively) and hydrargyri cum cretæ (gr. 1) q. 4. h.

April 18: During the night while the patient was asleep the penis became flaccid enough to fall over on the thigh, but so soon as he awoke it become erect and tense.

April 19: There is a noticeable change in the distention of the corpora and of the rigidity of the ischiocavernosus muscles. The penis hangs at an oblique angle to the abdomen and the patient now has no pain or discomfort.

April 21: Salvarsan 0.4 given intravenously. There is a marked change in the condition. The penis is no longer erect, but hangs loosely against the body. The corpora are, however, still somewhat distended.

April 23: Patient discharged. Penis is now permanently flaccid, but somewhat elongated and firm. He has had no return of erection.

August 29: Patient seen. Has had no return of erection but has had sexual desire, though much weaker than before the onset of the priapism, and ejaculation is only occasionally present after prolonged though infrequent attempts at intercourse. He has had no nocturnal pollutions.

NOTE.—This case was admitted to a ward of the Johns Hopkins Hospital in the service of Dr. Hugh H. Young to whom I am indebted for the privilege of reporting it.

CASE II.—W. D., negro fisherman, aged fifty-two, was admitted to Mercy Hospital, May 12, 1911, complaining of a painful erection which he had had for over 24 hours.

Patient has had pneumonia and typhoid fever, the last attack of gonorrhœa two years ago. Denies lues, although he says that he had a sore on penis at time of last gonorrhœa.

The onset of the present prolonged erection occurred suddenly in the night and was not preceeded by sexual or alcoholic excess or by any apparent cause. The patient, however, had been troubled for several months previously with frequent and painful nocturnal erections accompanied with frequency of urination and nocturnal incontinence. Eighteen years ago the patient had an erection unaccompanied with sexual desire which lasted for several hours and then subsided spontaneously and quickly. Since then he has had other attacks of short duration at infrequent intervals and for which he knows no cause. Aside from some burning there has been no trouble in urination. On examination the penis is seen to be in complete erection and is very painful, particularly on movement. There is a slight glairy mucous discharge from the meatus. First urine glass is clear, second one cloudy. Back of the corona is seen the scar of an old sore. Inguinal glands are slightly enlarged. Testicles, epididymis and prostate, normal. Atrophic scars on anterior surfaces of the tibia. Pupils are irregular but react to light and accommodation. Patellar reflexes are active on both sides.

May 15: Condition about the same. Given potassium iodide and lepullin.

May 16: Condition the same. Ice locally and to spine. Blood examination for leukæmia is negative.

May 17: Condition unchanged.

May 18: Wassermann reaction is negative.

June 16: Condition has remained unchanged. Patient is dis-

charged from the hospital 35 days after admission unimproved and with erection still present.

January, 1913: Patient lost, not to be found at address given.

NOTE.—This case occurred in the practice of Dr. A. G. Rytini, Baltimore, to whom I am indebted for the history.

Discussion.—The first case, in view of the immediate response to antisyphilitic treatment, is most likely the result of some luetic lesion of the nervous system. The striking feature in the case is the remarkable and prolonged spasm of the ischiocavernosi and the resultant partial character of the erection, the corpora cavernosa alone being involved. This muscle spasm might result from continuous irritation or inhibition either in the brain or in the cord. There was no evidence of any local genito-urinary infection which might cause spasm of these muscles through reflex stimulation. Furthermore, priapism due to such reflex causes is usually recurrent and transitory, as in the early history of the second case. Thrombosis, traumatic or infective, of the corpora is excluded by the early and relatively rapid subsidence, as well as by the observation that on the third night, during sleep, the condition was partially relieved, which would not have occurred if the cause had been local and mechanical.

In the second case there had been many previous urethral infections and, as is common with such infections, many recurrent and transitory erections. The prolonged attack was most likely the result of a secondary thrombosis of the corpora cavernosa, occurring in or following upon one of these reflex erections. Conditions would be ideal for the formation of a thrombus: infection, congestion and slowing of the blood stream and mechanical tension or injury. The persistent prolonged character of the priapism coincides with this assumption.

The Physiology of Erection.—An understanding of the physiology necessarily precedes a logical consideration of the pathology of erection. Normal erection is a reflex act, the immediate centre for which is assumed to lie in the lumbar cord. This centre may be acted upon by descending or by ascending impulses. The descending impulses come from a cortical centre in the cerebrum which receives its stimulation through the special senses (eyes, ears, nose) giving rise to erotic sensations and thoughts. The ascending impulses arise in some part of the genital tract. The glans penis is supposed to harbor the most sensitive of these afferent fibres, but the urethra, the spongy tissues of the penis, the prostate, the seminal vesicles, and even the bladder are all

assumed to have nerve fibres which may carry impulses to the erectile centre in the lumbar cord.

An erection represents a remarkable circulatory phenomenon of increased venous pressure. This increase in pressure is effected in two ways, by an augmented inflow and by a diminished outflow. The erectile tissues contain large venous spaces, freely anastomosing and in communication with their arterial supply without the intervention of any definite capillary system, and it is the marked overdistension of these spaces that produces the rigidity of the organ. The arterioles to these areas have both vasoconstrictor and vasodilator nerve fibres. The vasoconstrictors have been shown to arise (dog) from the second to the fifth lumbar nerves, to pass over to the sympathetic chain and thence to reach the penis either by way of the sacral sympathetic ganglia and their branches to the pudic nerves, or by way of the hypogastric nerve and pelvic plexus. The vasodilator fibres arise from the sacral cord (first to third, dog), pass by way of the nervi erigens to the pelvic plexus, and thence to the penis. Stimulation of the nervi erigens has been shown (dog) to produce a large dilatation of the arterioles in the erectile tissues, and augments the flow of blood to the part eight to fifteen times.

To this increased inflow in an erection is opposed a partial occlusion of the venous outflow. The efferent veins of the corpora cavernosa pass by way of each crus through the ischiocavernosus muscle, and that of the corpus spongiosum by way of the bulb through the bulbocavernosus muscle. The dorsal vein of the penis is the efferent outlet for the glans and has no constricting muscle other than intrinsic ones. These muscles are supplied by the pudic nerves and their contraction completes the act of erection by compression of these efferent veins which they surround, the occlusion not being complete, but enough to greatly increase the venous pressure in the erectile tissues. In addition to these special muscles there are smooth muscle fibres freely distributed throughout the spongy tissues of the penis, action of which, no doubt, has an intrinsic value in increasing venous pressure. It is seen, therefore, that erection is a complex nervous and circulatory phenomenon.

Classification of Priapism.—There have been several attempts to subdivide cases of priapism. The most complete and recent analysis was presented by Sheuer in 1911, who grouped his cases into those due to local causes and those to general diseases. The local causes he subdivided into:

I. Peripheral.
  (*A*) Produced through nervous influences (reflex).
    1. Through inflamed irritating conditions of the urethra and its glands.
    2. Through new growths or tumors of the anterior or posterior urethra.
  (*B*) Produced through mechanical causes in the spongy tissues.
    1. Through the spread of a disease process in the urethra into the spongiosum.
    2. Through the independent occurrence of local disease of the penis: (*a*) inflammatory in nature; (*b*) neoplastic in nature; (*c*) traumatic in nature.

II. Central.
  (*A*) Through anatomical disease of the brain or cord.
    1. Traumatic in nature.
    2. Neoplastic in nature.
    3. Inflammatory in nature
  (*B*) From functional disturbance of the brain or spinal cord.

The general diseases producing priapism he subdivided into:

I. Peripheral.
  (*A*) Infectious diseases (tabes, lues, etc.).
  (*B*) Intoxications.
  (*C*) Constitutional and blood disease (leukæmia).

II. Central.
  Intoxications.

The above classification, as well as those of Taylor, 1899; Pryce, 1903; Lohnstein, 1906; Blum, 1906; Terrier and Dujarier, 1907; and Laurent and Nové-Josserand, 1908, all of which are similar, though not nearly so complete, are too general for diagnostic purposes in the application of treatment, inasmuch as they are based upon etiologic rather than pathogenic considerations.

The distinct nervous and circulatory mechanisms of normal erections, although complex, indicate a dual pathogenicity for the pathologic manifestation, and every case in the final analysis may be grouped as due either to a nervous or a mechanical factor, or, as in Case II, to a definite combination of these.

A simple and practical classification of the cases of priapism, therefore, would be into:

1. Cases due to nervous causes.
2. Cases due to local mechanical causes.

The nervous causes may be simply subdivided into these:

(*a*) From ascending peripheral stimuli (reflex).

(*b*) From direct stimuli: (1) to the spinal cord centre; (2) to the nervi erigens or pudens.

(*c*) From descending cerebral stimuli: (1) direct; (2) indirect.

The mechanical causes may be subdivided into:

(*a*) Thrombosis, or pseudothrombosis.

(*b*) Hemorrhage and hæmatoma.

(*c*) New growths of the penis.

(*d*) Inflammatory swellings and œdema of the penis.

Analysis of Cases.—The meagre and poor histories in many of the reports render an attempt to arrange the cases according to the above classification additionally difficult. Nevertheless, the result, although inaccurate in part, is instructive and interesting.

Transitory Erections.—Erections of short duration are relatively common with all inflammatory conditions of the lower genito-urinary tract, and sometimes accompany certain diseased conditions of the nervous system. They are pathologic in the sense that they are painful and without sexual desire; but their frequent occurrence, short duration and tendency to recur, strongly distinguishes them from the uncommon, remarkable condition of prolonged and persistent erection. For this reason, the cases of recurrent or nocturnal erections of transitory reflex nature, about 43 cases reported in the literature as priapism, are not included as cases of true priapism. Many cases of priapism, however, are preceded by these transitory erections and, therefore, such cases are of importance as a factor of predisposition to the rarer and more serious condition. They may be of two kinds:

I. Local reflex forms of erections (acute transitory erections) which occur commonly with any abnormal condition of the lower genito-urinary tract, and which clear up permanently with relief of this local trouble. These forms are of small significance.

II. Painful erections, usually nocturnal and of short duration (chronic transitory erections), but of such frequent recurrence and over such a long period as to greatly interfere with sleep and with the pursuit of the patient's occupation. These transitory erections are mostly nervous in origin, as in tabes, sexual neurasthenia, etc. They may be so frequent and troublesome as to seriously impair the health of the individual. There are cases on record of recurring attacks of erection, of a few minutes' or hours' duration, lasting for 10 to 12 years, during which time every method resorted to failed to give relief. Curiously enough, these cases usually occur in men past middle age.

Fifty per cent. of the transitory erections reported in the literature were due to an ascending peripheral stimulation as the result of irritation from some disease or abnormality of the external genitals (urethritis, 12 cases; 100 cases reported by Hill not included; stricture, 1 case; chancroid, 1 case; herpes genitalis, 1 case; venereal warts, 1 case; polypi in posterior urethra, 3 cases; varicocele, 1 case).

Nine cases occurred in the early stages of tabes dorsalis. Six had some psychic cause. Three were the result of irritation of the brain or cord centre from infectious toxins, the erection recurring and subsiding with the rise and fall of the temperature. One case was the result of cantharides.

Priapism Due to Nervous Causes.—There were 35 cases that may be attributed to nervous causes.[1] Only three of these cases were the result of ascending peripheral stimulation, and these were all of only a few days' duration (venereal warts and phimosis, 1; anal fissure and phimosis, 1; polyp in fossa navicularis, 1). The remaining 32 cases were the result of descending impulses, 17 from the brain and 15 from the spinal cord. The 17 cerebral cases were both direct and indirect. Priapism resulted in one case from a tumor in the cerebellum. Another followed a rifle ball injury of the cerebrum, while a third was reported in an infant as a result of forceps injury to the head at the time of delivery. One case was indefinitely associated with epilepsy. Four cases were due to intoxications, three following cantharides and one accompanying diabetes. One case only was definitely associated with cerebrospinal syphilis. Five cases were associated with nasal polypi, the removal of the polypi being followed by an immediate cure except in one case in which thrombosis had evidently occurred to prolong the condition. These nasal cases have a peculiar interest in view of the observations of Mackenzie[2] and Fliess[3] on the

[1] Since writing this paper Shropshire and Watterston have reported (*Southern Med. J.*, 1914, vii, 320) a case of priapism treated by salvarsan, intravenously, 4 weeks after onset, with gradual subsidence within the next few days. Wassermann test was negative, but leutin test was positive. It is possible, in view of the long duration, that this case was mechanical in origin and the subsidence a coincidence and not the result of antisyphilitic treatment.

[2] Mackenzie, J. N.: "Irritation of the Sexual Apparatus as an Etiological Factor in the Production of Nasal Disease." *A. G. Med. Sc.*, April, 1884. "The Physiological and Pathological Relations between the Nose and the Sexual Apparatus of Man." *J. Hopk. H. Bull.*, 1898, ix, 10.

[3] Fliess, W.: "Die Beziehungen zwischen Nasr und Weiblichen Geschlechtsorganen in ihrer biologishen Bedentung Iargestellt." *Leipz. u. Wien.*, 1897, F. Denticke, 245 j., 8°.

interrelationship of the nose and the internal organs in women, and the external genitals in man. Fliess designates certain points in the nasal mucosa as "genital spots," which swell, bleed easily and are sensitive to the touch at the time of menstruation. These spots are located on the tuberculum septi and the anterior part of the inferior turbinate in either side of the nose. Mager[4] found he could permanently cure 50 to 75 per cent. of his cases (93) of dysmenorrhœa by a few applications of trichloracetic acid to these genital spots. Fliess and Mackenzie describe for the male analogous spots, pathogenic disturbance of which may set up a nasal reflex sexual neurosis, or *vice versa*, as considered by Mackenzie (being a laryngologist), the influence of pathology of the sexual apparatus is of importance in the production of nasal disease. The nerve path of this reflex is not known, but its existence would explain the pathogenesis of these five cases of priapism associated with nasal polypi, and suggests as well a therapeutic measure in certain cases of psychic priapism.

Fifteen cases of priapism were associated with injury or disease of the spinal cord. In one case in which the priapism had persisted for over a year, there was found at autopsy a general myelitis of the cord. In another case a new growth (sarcoma) was found pressing upon the cervical cord. The other 13 cases were the result of fracture, 11 being in the cervical region, 1 at the level of the third lumbar and another at the level of the second thoracic. In the fracture cases the priapism occurred at the time of the injury, and in most of the cases did not persist up to the time of death, but subsided spontaneously after a few days. It is of interest also that in several cases the erections were not complete. In five of the cases it is stated that complete erection would reflexly occur upon stimulating the glans. The ischiocavernosi were noted to be contracted and board-like in most of the cases. These cases are probably examples of loss of cerebral inhibition rather than due to cerebral stimulation.

In the discussion by Goetz, "Uber Erektion und Ejakulation bei Erhaengten" (About Erection and Ejaculation in the Hanged), no explanation is offered for the condition which is analogous to cases of priapism following injury of the cervical cord. In one case reported by Goetz, the man lived twenty-four hours after his neck was broken, and recovered consciousness. Ejaculation had occurred and erection persisted up to his death, although there was no sexual desire. Beck

[4] Mager: The Internal Treatment of Dysmenorrhœa. *J. Am. Med. Ass.*, 1914, lxii, 6.

makes an interesting observation in reporting a case of priapism accompanying a complete motor and sensory paralysis up to the level of the third intercostal space, in which it was found that the erection could be made to disappear by pressing the penis down, but that as soon as left in this relaxed position it could be seen to distend with each pulsation. Beck attributed the condition to paralysis of the vasomotor nerve fibres supplying the vessels of the penis. Loss of cerebral control may also result in the escape of impulses from the erectile centre to the muscles, which by their contraction would produce a circulatory obstruction and a partial erection. Howell states that no report has been made of erection occurring experimentally as a result of section of the vasoconstrictor fibres to the penis, as would be expected if the above observation and conclusion of Beck were correct. It is more likely that the cerebral inhibition produces both vaso-dilatation and muscle spasm in somewhat the same way as occurs normally in the case of nocturnal erections in sleep.

Priapism Due to Mechanical Causes.—There were 135 cases which had a mechanical or a combined nervous and mechanical element as a cause for the priapism. Thrombosis of the veins of the corpora was by far the most common factor, and can be assumed to have occurred in 125 of the cases. Sixty-four of the cases, in 55 of which there was thrombosis, followed sexual excess. In three of these there was a nervous factor, in that they had frequent short intermittent erections preceding the onset of the thrombosis and the priapism. In six cases the thrombosis accompanied a general infection (appendicitis, yellow fever, malaria, tuberculosis), and occurred as the result of a local cavernitis in ten and a local abscess formation in one case. Two cases were due to local luetic angioneurosis. In two other cases the obstruction was due to local new growths of the penis (sarcoma and carcinoma). Local injury produced hæmatoma or thrombosis of the venous spaces of the corpora with subsequent priapism in seven cases. There were 28 cases in which the priapism had been preceded by recurrent transient attacks of erection. The priapism, however, is really due to the mechanical factor, although it doubtless would not have occurred if the nervous element had not been present. Of these 28 cases, there were 2 tabetics, 5 neurotics, 3 with intoxication from cantharides, 3 with intoxication from some general infection and 15 with some local disease (urethritis, etc.), in all of which transitory recurrent erections preceded the final continuous and prolonged attack evidently due to a thrombosis.

Priapism occurred in association with leukæmia and gout in about

27 per cent. of the cases. This proportion is unexpected in view of the rarity of the condition in leukæmia. Cabot did not find a single case of priapism in his series of 89 cases of leukæmia and it has not occurred as a complication in any of the cases at the Johns Hopkins Hospital. Nevertheless, there are 45 cases that show a definite relationship to leukæmia. The pathogenesis is probably both nervous and mechanical in character. There is no evidence to indicate disease or direct irritation of the brain or spinal cord in these cases. However, it is possible that the condition of the blood tends to set up a reflex erection, which is then prolonged by a subsequent thrombosis. The evidence for thrombosis is convincing. Twenty-nine, about 70 per cent., had a duration of from twenty to sixty days. The corpora cavernosa were stated to be alone involved in 18 of the cases. Five cases were operated upon and thrombus found. The subsidence in the non-operated cases was slow, spontaneous and gradual. That the thrombosis is not the only factor is evidenced by the statement, in over 50 per cent. of the cases, of previous attacks of short duration, usually of the nature of nocturnal erections. The cases associated with tabes and those the result of an ascending peripheral reflex are similar to those with leukæmia in respect to a history of short previous attacks, or of bothersome nocturnal erections preceding the priapism. It is possible that the marked increase in white blood corpuscles brings about a distention or congestion in the vessels of the penis, which reflexly produces stimulation of the erectile centre and so causes these short, frequent, nocturnal erections. Many of the cases (stated in 14) had a sudden onset in the night, and thrombosis would be more apt to occur with the penis distended than when flaccid.

The four cases associated with gout are similar to the leukæmia cases and may be attributed to a thrombosis supervening upon a nervous reflex. They lasted from three to six weeks and all subsided slowly and spontaneously.

Nine cases in the literature are so incompletely reported as to be doubtful and are not classified.

SUMMARY OF ANALYSIS OF CASES

The above analysis of cases of true priapism shows that only about 20 per cent. are purely nervous in origin, and it is questionable whether a thrombosis had not occurred as the prolonging factor in some of these. Eighty cases (50 per cent.) were the result of both nervous and mechanical causes, the nervous factor being in most instances the

primary inciting cause and the mechanical factor the fundamental prolonging cause. The 45 cases occurring in the course of leukæmia are included here, although in most instances the condition may be well considered as purely mechanical in origin. Forty-five cases (30 per cent.) were of primary mechanical origin, although no doubt transitory nervous reflexes complicated the condition in some of these cases. It will be seen that mechanical factors are not uncommon. One hundred and thirty-five, or 80 per cent., have a local mechanical cause, either alone or in combination with a nervous element as the important factor.

Symptomatology.—There is no marked difference in the symptoms of the nervous and mechanical group of cases, except that over 80 per cent. of the nervous cases, as compared with less than 10 per cent. of the others, had a duration of less than 10 days.

Age.—Priapism may occur at any time of life, but is most frequent between the twentieth and fiftieth years (97 cases). There were 18 cases under twenty and 14 cases in men over fifty. The youngest case was in congenital syphilis and occurred shortly after birth. The oldest case was of nervous origin in a man of seventy-five (the age was not given in 40 cases).

Duration.—Excluding cases of transitory erection of only a few hours' duration, priapism is seen to persist from two days to over two years. Over 65 per cent. of the cases attributed to mechanical cause (thrombosis, etc.) lasted between 20 and 60 days. Eighty per cent. of the leukæmia cases had a duration of this character. On the other hand 85 per cent. of the nervous cases lasted less than 10 days (there was early death in 50 per cent. of these cases). There was slow and gradual subsidence of the condition in only one case of the nervous group, while a rapid subsidence was stated as occurring in about 50 per cent of these cases. Of the mechanical group 70 per cent. of the non-operated cases were said to have a slow and gradual recovery and in not one case was a speedy cure observed (the duration was not definitely given in 47 cases and the character of the subsidence was not stated in 65 cases).

Previous Attacks and Onset.—Previous attacks of a few hours' duration were stated to have occurred in 34 cases, 27 of which are in the mechanical group. This emphasizes the significance of intermittent or short attacks as an etiologic factor in the prolonged condition, and the importance of careful treatment of persistent painful nocturnal erections which so commonly accompany disease of the genitals.

The condition is not stated to have had a gradual onset in a single case. Sudden onset in the night is mentioned in 23 cases, 11 of which were in leukæmia. It followed coitus in 22 cases, of which 50 per cent. were after coitus interruptus, followed defecation in two leukæmia cases, and came on after an enema in one case. The onset was sudden in all of the cases (not stated in 56).

Character of the Erection.—This was stated in 63 of the histories and in 43 of these, 70 per cent., the corpora cavernosa alone were involved, the glans and spongiosum not taking part in the erection. Thirty-eight of these are in the mechanical group (18 in leukæmia). In the 5 other cases the priapism was the result of a fracture at the level of the cervical cord and it was noted in all these 5 cases that a complete erection would follow stimulation of the glans which would soon subside, leaving the corpora alone erect. In these 5 cases there was spasm of the ischiocavernosi. In 10 other nervous cases the whole penis is stated to be involved, while in only 10 of the mechanical cases was a complete erection observed to be present.

Pain.—The condition was not uniformly painful. In some cases there was little if any discomfort. In the great majority of the cases, however, there was pain present, particularly on handling. In a few cases this was extreme, particularly in those cases due to a nervous reflex.

Urination.—Urinary symptoms were mentioned in 73 of the cases. In 60 there was frequency, difficulty or retention. Several cases had to be catheterized. In only 13 is it stated that urination was undisturbed. These disturbances are associated in the great majority of the cases with a complete erection, *i.e.*, erection of the corpus spongiosum.

Sexual Desire.—There was loss of all sexual desire in 107 of the cases (not mentioned in 60 cases). In three cases in the nervous group there was at first an increase in sexual desire which was only temporary, as subsequently, except in the case of Donne in which death occurred early, there was loss of all desire.

Ejaculation.—This was not observed to have occurred at the onset of the priapism in any case except in those cases in which the condition followed coitus. Attempts were made in several cases to relieve the condition by coitus and in most cases a normal ejaculation occurred, but with an aggravation rather than a relief of the priapism. After the priapism had subsided and before a return of the power of erection attempts at coitus were followed in 11 cases by normal ejaculation.

This supports the fact that the centres for erection and ejaculation are at a different level and are separate.

Subsequent Power of Erections.—Inability to have an erection after the subsidence of the priapism was observed in only 17 of the cases and, inasmuch as the time of observation in most of these had been for a few months at the longest, presumably all of them may have eventually recovered this function. A recovery of the ability to have an erection was mentioned in 36 of the histories. In several cases a slow or partial recovery was noted, it being a frequent observation that the early erections following priapism, and particularly when due to thrombosis with cavernitis, were crooked or that the distention was greater in one corpus than in the other. A recovery of the power to have normal erections was noted relatively much more frequently in the nervous group of cases than in the mechanical. The loss of the power of erection was not mentioned in a single nervous case but there were 17 deaths in this group.

Mortality.—In not a single case was death attributable to the priapism. There were 33 deaths, 11 from leukæmia, 18 following cerebral or spinal cord injury, 2 from pyæmia, and 2 of doubtful cause. The erection persisted after death in 3 cases.

PATHOGENESIS

Priapism may follow or accompany a great variety of conditions. This protean character of its etiology has led to considerable confusion in establishing its pathogenesis. A normal erection is a complexity of nervous and circulatory factors. The circulatory factor is effective through a special anatomical arrangement of blood-vessels, whereby obstruction to circulation results in congestion of the venous spaces under arterial tension. In this sense a normal erection is mechanical. The pathologic condition is also always mechanical, but may be due to obstruction from nervous reflex spasm of the muscles partially occluding the efferent vessels as in a normal erection; or to obstruction to venous outflows from intrinsic cause, such as thrombosis or hæmatoma of the vessels.

There have been various theories advanced to explain priapism. Thrombosis has been considered as a factor in some cases, the remaining cases being attributed to complex nervous elements. Recently Worms and Hamont[5] advance the idea of a diagonal passage of the

[5] Worms, G., and Hamont, A.: Sur le priapisme prolongé et son traitement. *Chirurgicale Gazette des Hôpitaux*, 1913, xliv, 709.

efferent vessels through the sheath of the corpora cavernosa, which in congestion binds these vesesls at this point so as to produce priapism. They consider all cases as due to this factor. However, if this were the explanation of the condition, one would expect priapism to occur much more frequently than it does, as this factor is present in all men. It is true that the anatomical structure and arrangement are at the bottom of priapism, but only in connection with other factors, which occur only occasionally. Our analysis shows that nervous causes for the condition are exceptional, and that most cases are apparently due to some form of obstruction, of which thrombosis is the most common. This is possibly not a true thrombosis in many cases, but the evidence in favor of the existence of at least pseudothrombosis is most convincing. In all the operative cases a definite thrombus, or thick, grumous or coagulated blood was evacuated. In the non-operative cases the condition subsided spontaneously and gradually, and in three cases the erection persisted after death. The frequent observation of erection of the corpora cavernosi alone also favors the theory of obstruction.

As is well known, there are a number of variable conditions closely related to the occurrence of thrombosis. There is no single cause. Its chief factors are generally held to be (1) slowing in the blood stream and the formation of eddies; (2) changes in the vessel wall itself, such as endothelial injury; (3) increased coagulability of the blood plasma; and (4) increased agglutinability of the blood elements. Aschoff [6] believes that neither endothelial damage nor increased coagulability play any rôle in static and toxic capillary thrombosis, but that a slowing of the blood stream and an increased agglutinability of the blood platelets are the important factors, and that thrombus formation cannot occur without their coexistence, but that in static and similar types of thrombi, the slowing of the blood stream is of prime importance; whereas in the toxic varieties, changes in the blood elements play the greater rôle. Infection, according to Aschoff, plays a secondary part in the formation of thrombi, and when present usually supervenes upon an already existing simple thrombus. In the case of local infection (such as cavernitis of the penis) it might progress along the vessel wall and produce first a phlebitis, to be followed by a secondary thrombosis by deposition (phlebitis thrombosis—Aschoff).

[6] Aschoff, L.: *Deutsche Naturforsches und Aertzte*, 1911; *Arch. Int. Med.*, 1913, xii, 503.

The first stage in thrombus formation is the erection in a slowed blood stream of a morphological structure of blood platelets or leucocytes by a process of deposition and agglutination. In the second stage, coagulation occurs by the formation of fibrin ferment. These principles may be applied to the causation of priapism. There is a slowing of the blood stream with a widening and stretching of the vessels and formation of eddies. Blood platelets or leucocytes are deposited, and in case the factor of agglutinability is present, are cemented together, so as to plug the vessels. Later there may or may not be the liberation of fibrin and coagulation.

According to these ideas, transitory erections, probably, are all nervous in origin, but cases of true priapism may be either nervous or mechanical. The nervous cases are relatively few and are apparently due to a prolonged spasm of the ischiocavernosi muscles, or to a complex of nerve stimuli as in normal erection. The mechanical cases comprise the majority. They are almost invariably preceded by nervous causes. These incite an erection, which is prolonged by local obstruction by the formation in the stagnant, congested blood stream of either pseudothrombi or true thrombi. In a few cases mechanical obstruction is effected by the presence of a tumor, of a hæmatoma or a hæmatocele. No doubt even in these cases, however, there is also additional mechanical obstruction from pseudothrombosis, as is evidenced by the absence of unilateral or localized erections.

DIAGNOSIS

It is important for purposes of treatment that the four groups of pathologic erections be differentiated. The acute transitory reflex erections differ from chronic recurrent erections only in degree. Both are of short duration, are painful and are unaccompanied with sexual desire. The former are mostly associated with disease of the genito-urinary tract and disappear with improvement of the local condition. The latter are more often associated with some marked nervous disturbance, such as tabes or a marked psychosis, and are often extremely resistant to all medication and may persist for years. This chronic character renders the condition serious. Each group may occur during either the night or day, although the chronic group have erections more frequently during the waking hours. The transitory erections are complete in character, no case being on record of erection of the corpora cavernosa alone. They usually subside quickly if the patient awakes (when nocturnal) or after urination, or sometimes only after he gets up and walks about or does something to distract his mind.

They last from a few minutes to a few hours. The transitory reflex erections are significant only as a predisposing factor to priapism, but the chronic recurrent erections are, in addition, frequently of so serious a nature as to demand radical measures for their relief.

In true priapism it will be difficult to differentiate between a nervous and a mechanical cause. A blood examination should always be made, and if leukæmia exists, the case is most likely mechanical. If the patient has a brain or spinal cord injury, the priapism is as definitely nervous. The previous history is of importance with respect to attacks of transitory erections, which frequently precede a mechanical priapism. The nature of the onset, whether following sexual excess, coitus interruptus, or sudden onset in the night, is significant of a mechanical cause. If the case has persisted for more than six or seven days, it is more likely mechanical. In case the corpora cavernosa are alone involved and the ischiocavernosi are not chronically contracted, the case is almost sure to be mechanical. The genito-urinary tract should be carefully examined. Priapism following local disease or injury is almost always mechanical. The cases cited by Hobbes suggest elimination of the possibility of some nasal disease which might incite a nervous priapism. The possibility of a cerebral or spinal cord lues should be eliminated. In the case of tabes there will have been previous nocturnal erections and the condition will be mechanical. The probabilities in the absence of a brain and spinal cord lesion are greatly in favor of a mechanical cause for the condition.

The condition of satyriasis should offer few difficulties. It may, however, be accompanied with a persistent erection, as in the case of Donne, and the condition may lead to thrombus formation and mechanical priapism.

TREATMENT

There has been no definite method of procedure in the treatment of priapism. Internal medication has no apparent effect. In many cases leeches were applied to the penis and perineum, with no result. Almost all the sedatives and hypnotics known to medicine have been tried and found futile, and even deep narcosis gives no relief. The condition has been treated by operation in 34 cases. In one case the dorsal arteries of the penis were ligated with a cure. In the other cases, incision of one or both corpora cavernosa was practised and with immediate benefit in all but two cases. In one (Dawson) the incision was apparently too superficial to relieve the obstruction, and the case gradually and spontaneously subsided after 11 days. The other case (Sothron) was of

nervous origin and persisted in spite of all medication, and even after incision of the corpora.

The subdivision of the cases into four groups suggests the need of a different procedure in the treatment of each group.

Treatment of Transient Erections.—This will depend largely upon the etiological factor. In case the recurrent nocturnal erections are the result of an ascending peripheral stimulation from a urethritis, stricture, herpes genitalis, etc., satisfactory treatment of the local disease gives permanent relief. In case tabes is present, recurrent erections may not respond to any form of internal treatment, even antisyphilitic, and certain psychic forms of the condition are equally stubborn. Lewis cured one case of over two years' duration by ligation of both dorsal arteries of the penis. In case of repeated recurrences, in spite of sedatives and thorough local and general treatment, some operative measure along the same lines as for nervous priapism should be undertaken.

Treatment of Priapism of Nervous Pathogenesis.—These cases should have thorough general treatment before subjecting them to operation. Eighty per cent. have a duration of less than ten days, and furthermore the general condition of these cases, particularly those of brain or spinal cord injury, is so serious that the priapism is of minor and secondary importance. Those few cases, however, in which the priapism is the serious feature, and which persist for more than a week, should be relieved by operative means.

Several operations suggest themselves:

1. It would be possible to expose the pudic nerves in the perineum and inject their sheaths with some drug, or to divide them with a knife. The superior terminal division of the pudic nerve with the dorsal arteries penetrates the ischiocavernosus muscle on each side, and supplies this muscle as well as the vessels and intrinsic muscles of the corpora cavernosa and glans. Blocking of impulses carried by it would relieve the spasm of the erector muscles and the erection of the corpora.

2. The two dorsal arteries of the penis can be exposed close to the pubes and ligated, as was done by Lewis. This would prevent an increased blood flow to the corpora and relieve their erection.

3. The ischiocavernosi muscles themselves may be divided in the perineum, and the nerve and artery with them. To what extent the power to have future erections would be destroyed by any of these three procedures is problematical. Lewis does not mention this point in his case.

Treatment of Priapism of Mechanical Pathogenesis.—There seems to be one simple and effective form of operation for this form of priapism, no matter what its particular etiology may be. This is by incision and drainage of either one or both corpora cavernosa. A single incision, inasmuch as the blood-vessels of the corpora anastomose freely, is about as effective as double incision. In the 33 cases in which this operation has been done, there was immediate cure in all but two cases (in one the incision was apparently not thorough enough, and the other in which the operation failed was one of nervous pathogenesis). Worms and Hamont have advised this operation for all forms of priapism, but it would seem to be applicable to the mechanical form only. The operation does not destroy the power of future erections. Priapism even may follow, as occurred in one case several months after the operation. These very favorable results recommend an early and thorough incision of one or both corpora cavernosa in all cases of mechanical priapism.

Technic of the Operation.—Unfortunately few of the operators have indicated (no one clearly) the procedure followed by them in opening the corpora. The incision in a majority of the cases has been made a little back of the midpart of the corpus on the dorsolateral surface. The mid-dorsum and ventrum are to be avoided because of the dorsal vessels and nerves above and the urethra below. It seems important that this incision should extend well into the spongy tissue of the body and be of sufficient length to allow of the contents to be thoroughly evacuated. In many of the cases both corpora were opened; in some others only one incision was made on one side and the opposite corpus emptied through this (the vessels of the two anastomose). The fibrous sheath of the corpus should be completely slit and the incision extend deeply into the spongy tissue or the veins and spaces will be with difficulty and only partially emptied.

The contents are described as consisting of "black grumous blood," "thick clot," "thick coagulum," "coagulated blood," etc. No definite thrombus is mentioned nor described for any of the operative cases. Kast found at autopsy, in his case, "large leukæmic thrombi" in the corpora cavernosa. The corpora are only emptied after considerable squeezing and manipulation, and it has been necessary in some cases to make secondary incisions into the spongy tissue through the primary skin opening in order to completely empty the organ of its contents. In all cases the entire corpus seemed involved in the process. In no case was there excessive bleeding afterward. Usually a small wick or

rubber drain was inserted and the skin and fascial sheath closed with interrupted or continuous suture.

Perfect asepsis during and after the operation would seem to be of considerable importance, inasmuch as several of the cases subsequently became infected and suppurated for some time and a number of urinary fistulæ are reported with these cases. A number of the cases (following cavernitis) were already infected at the time of the operation. The ultimate results as to the character of subsequent erections, the formation of scar tissue at the site of the incision and as to whether this scar was tender and painful on erection or not, etc., is stated in none of the accounts.

The following few cases will serve as example of the different forms of priapism:

Cases of Nervous Origin.—DUKEMAN: Has had persistent priapism for five months, and previously, at intervals, for months at a time. Father was an officer in the English army stationed in the South Sea Islands. Son was stolen by natives at the age of seven and not recovered for four years. Used during this time as idol by the natives who practised with him the habit of satisfying their sexual desires by the act of suction. Habit acquired by boy and would often have violent spasms of the penis lasting several days and only relieved by practising the above act himself. Married at sixteen. Three healthy children. Free of trouble till after death of wife nine years ago when old trouble returned. Intercourse aggravates the condition. No medication gives relief.

HOBBS: Patient came to office with frontal headache and nasal stenosis. Strabismus operation. Awoke next morning with a painful priapism, came to office several days later and adnephrin and cocaine applied to nasal mucous membrane with, inside of 30 minutes, a decided change in the priapism.

KOCHER: Patient fell out of a tree on back. Had severe priapism, bladder filled but no difficulty in urination. Corpora cavernosa were alone involved but glans and spongiosum could distend on stimulation of glans. Thirty-three years old. Priapism persisted to death several days later. Autopsy: Total dislocation between the sixth and seventh cervical vertebra with destruction of the seventh cervical spinal segment and of the lower part of the sixth.

Cases of Mechanical Origin.—DAWSON and GOEBEL: Age thirty-eight. Has had intermittent attacks of transitory erections for the last eight years. No gonorrhœa. Present attack came on suddenly after sexual excess. Urination painful. Responded to no therapeutic measure, not even deep anæsthesia. Corpora cavernosa alone involved. On the twenty-third day an incision made in the corpora from which thick coagulated blood was evacuated without effect. A second incision three days later followed by immediate cure. Duration of priapism 26 days.

TRIPE: Twenty-six-year-old patient had priapism following coitus with no apparent cause. Lasted three months and not affected by the most varied

treatment. The erection in the corpora cavernosa persisted for some time after that in the spongiosum had subsided, and then disappeared very gradually after several days.

VORSTER: Onset of priapism following a kick in the scrotum with bleeding from the meatus and retention of urine. Catheterization even under ether, which had no effect on the priapism, impossible so that an external urethrotomy was necessary. Tumor could be seen projecting into the urethra which on opening proved to be a hæmatoma of the right cavernosum and was filled with partly coagulated blood, emptying of which immediately relieved the priapism.

SCHEUER: Area of induration on the right side of the body of the corpus cavernosum, which for some time has been sharply curved to that side when in erection, rendering coitus difficult. During the night after an unsuccessful attempt at coitus patient suddenly seized with an intense priapism, very painful, involving mainly the corpora cavernosa. After persisting two days the right corpus cavernosum was incised and a great deal of partly coagulated black blood was evacuated, giving immediate relief.

DUJON: Convalescent from a severe diphtheria. Seized suddenly in the night with a painful erection which persisted. On examination presented a large spleen. Blood count showed 132,000 leucocytes of which only 25 were polymorphonuclears. The corpora cavernosa were alone involved in the erection. After several days the root of the left corpus cavernosa was incised at the point where it passes through the ischiocavernosus. Immediate relief, but no return of erections on last observation several months later.

HAILLOT ET VIARDIN: Age thirty-four, for the past year patient has been having erections almost every morning which last from two to three hours. No sexual excess. No genito-urinary disease. Spleen much enlarged and blood picture typical of leukæmia. Corpora cavernosa swollen and tense while the glans and spongiosum were not involved. All medication without effect. After 25 days the corpora were opened by two deep incisions and thick coagulated blood emptied out with relief of the priapism.

Cases of Transitory Erections (Chronic and Acute).—PITRES: Age sixty, lues 25 years ago. Lancinating pains and hypersensitive areas in the thighs 11 years ago. Soon after began to have erections of variable length without sexual desire which were so intense as to keep him awake. These lasted intermittently for over a year. Then became ataxic and nightly erections persisted. No medication helped.

FRANK: Age thirty-one, gonorrhœa 12 years ago. Complains of nocturnal erections which are very painful and cause much loss of sleep. No sexual desire. Several small polyps found between the verumontanum and the mouth of the bladder, removal of which cured the condition.

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RUPTURE OF THE BLADDER*

REPORT OF AN UNUSUAL CASE

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This case of intraperitoneal rupture of the bladder seems sufficiently interesting to report, for the following reasons: First, that the case was not operated upon until 24 hours after the rupture; second, that the rupture of an apparently healthy bladder occurred without any sign or history of direct injury to the organ.

The patient, a male, forty-five years old, of medium height, weighing 194 pounds, was brought into Bellevue Hospital on the afternoon of April 22, suffering from severe abdominal pain, with inability to pass his urine. His past history was negative as to the present condition; his habits were those of a periodic alcoholic.

At ten o'clock in the evening, when called to the hospital, I was told that on admission late in the afternoon the patient was catheterized and 20 ounces of bloody urine were recovered. The temperature at that time was 99°, pulse 100, respirations 22. As there was nothing to arouse anxiety and as his real condition was not suspected, he was allowed to remain undisturbed until the evening, when he was again catheterized. This time 8 ounces of bloody urine were recovered and 4 ounces of boric acid solution injected into the bladder, of which only 2 ounces returned.

On physical examination I found the patient with flexed thighs; with a large pendulous abdomen, rigid and tender to pressure over its lower and anterior aspect, with no sign of traumatism, no tenderness in the renal regions; the abdominal walls so thick that percussion was almost of negative value, though there seemed to exist some dulness of the flanks.

The patient's general condition was good, with no sign of shock. He said that on the previous evening after a day of heavy drinking, he had slipped and fallen down four or five steps in a sitting posture. He was immediately nauseated and vomited the contents of his stomach. He then started to walk home, twenty blocks away, and though seized with severe abdominal pain, he was able to reach his home, undress and go to bed. After a sleepless night, due to continued abdominal distress, he rose, dressed about noon and requested that an ambulance be sent for, and he reached the hospital as previously mentioned.

Without further urinary examination the patient was prepared for operation. The usual suprapubic exposure showed a bladder extra-

* Read before the American Association of Genito-Urinary Surgeons, May, 1914.

peritoneally intact. The incision was carried upward to the umbilicus, in order to get sufficient exposure through the usually thick abdominal walls; the abdominal cavity being opened, a considerable quantity of urine and blood clots were mopped out. The patient was then put in the Trendelenburg position and the abdominal contents packed off with pads, and a jagged transverse rent in the roof of the bladder, easily admitting three fingers, was found. This being the extent of the injury as far as could be seen, immediate repair was undertaken, and the rent closed by three layers of catgut sutures, placed successively through mucous membrane, muscular and peritoneal coats.

The abdominal cavity was then closed in the usual way, with a cigarette drain and a catheter retained in the bladder. The patient sustained practically no shock from the operation and the post-operative course was uneventful, except for three days of uncomfortable abdominal distention and a slight fascial infection, due to faulty chromic gut. The retention catheter was removed after eight days and the patient was catheterized for a period of three or four days, after which he was able to pass his urine easily. He was out of bed on the fourteenth day, and at the time of making this report, the nineteenth day after operation, he seems perfectly well and strong.

In referring to the literature it is of interest to note the fall of mortality of operations in intraperitoneal rupture of the bladder. From an analysis of 93 cases collected by Watson and Cunningham up to 1906, the mortality was 42.2 per cent. According to Thomson-Walker, an analysis of 78 cases gave a mortality of 43.5 per cent., and when only the last six years were taken, the mortality fell to 20.5 per cent. The earlier the operation is performed the better the prognosis. The longest period of delay, when operation resulted in recovery, seems to be that of Quick, who reports a case in the ANNALS OF SURGERY, 1907, of a patient who was not operated upon until 254 hours, or almost 11 days, after injury.

A factor in making the mortality higher than statistics would suggest is that probably a large number of single cases, which are operated upon and die, are never reported, as against the successful cases, which the surgeon takes pains to record.

OPERATIVE TREATMENT OF ACUTE EPIDIDYMITIS*

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Our attention has been called to the meagre statistics on the operative treatment for the relief of acute epididymitis, by an article recently published by Captain L. S. Eckels, Medical Corps, United States Army, and in reviewing the literature on the subject we find in the pioneer work of Dr. F. R. Hagner, of Washington, and Dr. L. Bazet, of San Francisco, a stimulus to report our observations after reviewing over 300 cases in Ancon Hospital since 1908, in which operative treatment gave most gratifying results.

Acute epididymitis has a sudden onset with occasional prodromal symptoms as pain along the cord of the affected side and at the internal ring, or pain in the sacrum, but the case is usually well developed and the pain in the epididymis severe when the patient first seeks treatment. The picture is characteristic with a swollen and exquisitely tender epididymis. However, in two cases of right-sided epididymitis accompanied by vomiting, the tenderness was so great along the right side of the abdomen that the possibility of a coexisting appendicitis could not be ignored.

The temperature on admission ranges from normal to 104° F. and may be preceded by a chill and accompanied by severe prostration. Swelling comes on suddenly, the tail of the globus minor being first affected, and, with non-operative treatment, reaches its height in three or four days. An acute hydrocele develops in a small percentage of these cases, giving an additional indication for operative treatment. If hydrocele is not present the enlarged epididymis engulfs the testicle. The pain is severe and more intense when accompanied by an acute hydrocele. A prone position and support to the scrotum mitigate the pain. Without operation all pain usually subsides in two weeks, after which swelling gradually diminishes, often leaving a permanent nodule in the tail of the epididymis.

Epididymitis is usually due to gonorrhœa or septic infection of the urethra, and when the epididymitis begins the urethral discharge dimin-

* Read before the Canal Zone Medical Association, June 20, 1914.

ishes or even ceases, to return again after the epididymitis subsides. The disease usually occurs after the second or third week of gonorrhœa and is estimated to be a complication in ten per cent. of all cases of gonorrhœa, regardless of the method of treatment. However, instrumentation, forcible irrigation and alcoholism during the course of an acute gonorrhœa predispose to epididymitis, and one attack predisposes to subsequent attacks.

Usually only one side is involved. The infection extends along the vas deferens to the epididymis where the epithelial lining of the tubules is infiltrated with round cells and becomes mucoid and desquamated, often blocking the tubules and causing distention of the canals by retained secretions. Degeneration and glandular atrophy follow and hyperplasia of the fibrous stroma results, forming patches of functionless tissue.

Surely, then, we find in acute epididymitis a condition warranting early operative interference. The extent of damage to the tubules is lessened by operation, the relief of pain is immediate, and recovery is much more rapid and complete.

Various methods of operation have been followed in our series of cases with equally good results, the primary object being to make multiple small punctures in the epididymis which can be done with or without delivering the testicle. If hydrocele or abscess be present they are treated radically, but in uncomplicated acute epididymitis an incision so small that no sutures are required is quite sufficient through which to puncture the epididymis, and is followed by the same good results that obtain in all of our cases.

An operation that appeals to us is as follows: After shaving the parts thoroughly we use a 3 per cent. alcoholic solution of iodine. External and parallel with the epididymis, make an incision into the tunica vaginalis. This incision should be large enough to deliver the testicle. Examine the epididymis and make multiple punctures with a blunt probe in that portion which is inflamed. Gently massage the part, wash with warm salt solution and return testicle to scrotum. Close the tunica with catgut and insert a narrow iodoform gauze drain. The external wound is closed with silkworm gut, using the subcuticular stitch—the drain passing out at the lower angle.

After operation we apply a sterile gauze dressing and a suspensory bandage is used to support the scrotum. On the second day the wound is inspected and the iodoform drain is removed. Daily dressings are not necessary. Usually on the fourth day the patients are up and allowed the freedom of the wards and porches. On the fifth day we

apply a 2 per cent. alcoholic solution of iodine over the line of incision and remove the sutures if silkworm gut has been used. In the majority of cases patients return to duty on the sixth day.

A great deal of interest has centred around the possibility of sterility following double epididymitis both in the operative and non-operative cases.

Cunningham of Boston reports 6 cases in which he operated bilaterally. Two of these patients have had children since the operation; two showed living spermatozoa in the semen, and the remaining two showed no spermatozoa in specimens obtained by massaging the vesicles. Our records show a number of bilateral epididymotomies without, however, observations as to sterility. One case in which we operated recently is of interest:

> Patient, Hospital No. 162091, was admitted to Ancon Hospital, May 19, 1914, with a history of gonorrhœa of one month's duration and "swelling in right testicle" which began 10 days before admission. On examination a slight purulent urethral discharge was observed, an acute epididymitis on the right side, and a temperature of 102° F. On May 20, under general anæsthesia, the globus minor of the right epididymis was exposed through a small incision in the right side of the scrotum and several small punctures were made into the epididymis. A small iodoform drain was inserted and the incision closed with a single catgut suture. The pain was relieved at once and the temperature fell to normal in 48 hours and remained so until one week later (May 28), when an acute epididymitis developed on the left side. In 12 hours the temperature rose from normal to 101° F. and the epididymis was so exquisitely tender that it could scarcely be palpated without causing excruciating pain. Two hours later a small incision was made under ethyl chloride anæsthesia through which the flattened end of a silver probe was inserted and the epididymis punctured. A few hours after operation the patient volunteered the statement that, although he had suffered severely during the night preceding the operation, pain was relieved immediately after the epididymis was punctured. The temperature fell to normal in 12 hours. Condom specimens of semen were examined 2 weeks after operation and motile spermatozoa were found. The urethral discharge returned after operation and patient remained in hospital for gonorrhœal treatment.

Success depends on operation. We should not persist in using non-operative measures when the patient's consent to operation can be obtained. The results are appreciated immediately by surgeon and patient. All symptoms disappear rapidly, and the patient is usually free from pain when he recovers from the anæsthetic. The temperature rapidly falls to normal and the pulse becomes normal. In over 300 cases in this clinic the average duration of temperature after operation was 36 hours. In one of our cases the temperature fell from

103.6° F. to normal in 12 hours. In this series of over 300 cases no relapses have been noted. Captain Eckles, M.C., U. S. Army, reports that in a series of 100 cases under his observation no relapses occurred. Dr. Francis R. Hagner, of Washington, also reports that no relapses have occurred in his patients. The persistent nodular condition of the globus minor that we see so often in cases of epididymitis which are not treated promptly does not follow operative treatment. The fall of the leucocyte count is marked. Hagner reports a case in which the leucocyte count fell from 33,000 to 8,400 in 48 hours. We have searched the meagre literature on the subject and found no record of infection following the radical operation. We have found but one case in which absolute relief from pain did not follow operative treatment. This case was reported by Hagner as "a very acute and severe form of epididymitis of 3 days' duration in a very nervous young man, in which there were from thirty to forty miliary abscesses scattered through the epididymis." But he further states that in 24 hours after operation the pain entirely disappeared and the patient made an uninterrupted recovery. Assistant Surgeon Knight, U. S. P. H. Service, reports 5 cases in which he used a modification of Eckels' technic, and his observations are about the same. The success that Knight has had with novocaine as a local anæsthetic is to us unusual.

CONCLUSIONS

The above paper owes its origin to the desire to stimulate interest in an operation which is rapidly becoming popular with genito-urinary surgeons.

Epididymotomy is the rational thing to do because it shortens the duration of the disease; relieves the severe, weakening, sickening pain at once, causes the temperature to fall and induration to disappear rapidly. What is radical to-day is conservative to-morrow.

(We wish to thank Col. Chas. F. Mason, M.C., U. S. Army, Chief Health Officer of the Panama Canal, for permission to publish this paper; also Dr. A. B. Herrick, Chief of Surgical Clinic, Ancon Hospital, for permission to use the material.)

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HYDRONEPHROSIS

AN EXPERIMENTAL STUDY*

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and

W. Howard Barber, M.D.

of New York City

In the course of a study of the causative factors of renal infection, the association of paralysis of the ureter and dilatation of the kidney pelvis and calyces was so frequent as to suggest experimental observations on hydronephrosis. The latter lesion may be defined as dilatation of the pelvis of the kidney by fluid attended by secondary dilatation and final obliteration of the calyces and by mechanical compression and atrophy of the parenchyma.

Clinicians [7] explain the etiology of hydronephrosis in assuming mechanical obstruction to the outflow of urine by foreign bodies, neoplasms, inflammatory exudates, and the like.

Wagner,[9] of Leipzig, describes the possible effects of traumatism to kidney and ureter. That traumatism gives rise to ureteral stricture or to peri-ureteral extravasation which may obstruct urine outflow and distend the kidney, he certainly affirms; that the intra-ureteral hemorrhage may coagulate and cause obstruction he faintly suggests. Ureters have been traumatized by ligation. They have been tied off experimentally as well as unwittingly. Experimentally "Guyon [11] and Albarran found congested kidney" after 57–70 hours of urethral ligation expressed by him in the following measurements:

Right kidney	P.M.	A.M.	Left kidney	P.M.	A.M.
	cm.	cm.		cm.	cm.
Length.....	5.5	5.0	Length	5.8	5.5
Breadth.....	3.3	2.7	Breadth	4.0	2.8
Thickness	3.3	2.7	Thickness	4.0	2.9

Bradford [5] ligated the ureter for 11–40 days. He found the ureter always completely obstructed and the kidney invariably distended so that on incision at second operation 50–70 c.c. of urine was liberated. Most frequently, hydronephrosis resulted; in three cases out of twelve, pyonephrosis followed. Both Guyon's "congested kidney" and Brad-

* Conducted at Laboratory of Experimental Surgery at New York University Medical School.

ford's hydronephrosis were transitory conditions associated with marked atrophy. Rayer avoids the association of complete obstruction and hydrorenal distention. Keen and Morris maintain that complete sudden obstruction brings about a rapid atrophy following a transitory distention. With this we agree. Experimentally both of a dog's ureters were stripped and one was ligated firmly at the ureterovesical junction. The animal lived for five days in a drowsy indolent state. At autopsy both kidneys were found hydronephrotic, the ligated ureter-kidney twice the size of the nonligated ureter-kidney. The measurements were as follows:

Right kidney	P.M.	A.M.*	Left kidney	P.M.	A.M.*
	cm.	cm.		cm.	cm.
Length	9.0	6	Length	7.0	6
Breadth	6.0	4	Breadth	5.0	4
Thickness	4.0	2	Thickness	3.0	2

TABLE I

EFFECT OF STRIPPING URETER COMPARED WITH EFFECT OF STRIPPING AND LIGATING URETER

Experimental Surgical Laboratory, N. Y. U. 1913–14

Hydronephrosis

Dog No.	Gross Findings †	Microscopical Findings	Cause of Death	Days of Life
146	Left: Hydronephrosis, slight	Diffuse glomerular and intertubular congestion	Hydronephrosis	5
	Right: Hydronephrosis, slight	Local congestion; parenchymula degeneration		

Obstructive inflammation of the urinary tract may be acute or chronic. Delbet [8] and others report ulcerative pyelitis or ureteritis following calculus irritation. Oertel [10] reports a singular inflammatory change in the kidney pelvis analogous to the connective-tissue hyperplasia in productive senile arteritis which permits distention under normal conditions of intrapelvic pressure.

Morris [3] reports many interesting anomalies of the ureter and the renal arteries obstructing urine delivery to the point of renal distention. Van der Bogert [6] reports a congenital type of hydronephrosis following aplasia of the ureter.

* Estimate measurements.

† "Left" and "right" refer to animal and are reversely represented in table and in Fig. 8. Congestion is more marked in ligated ureter-kidney and degeneration has begun.

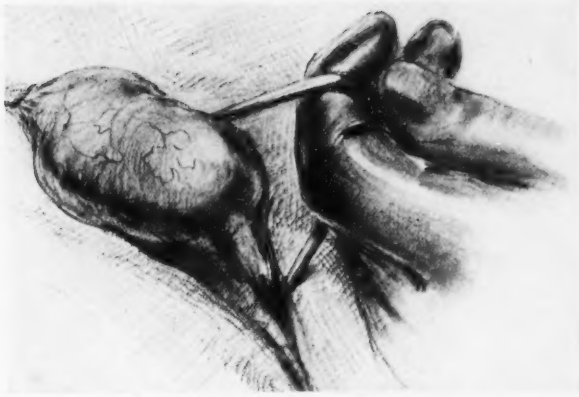

FIG. 1.—One of the steps in the technic of isolating and stripping of ureter, and irritating suppositional ureteral nerve plexus.

FIG. 2.—Pyonephrosis following stripping of the ureter. Other kidney and ureter normal.

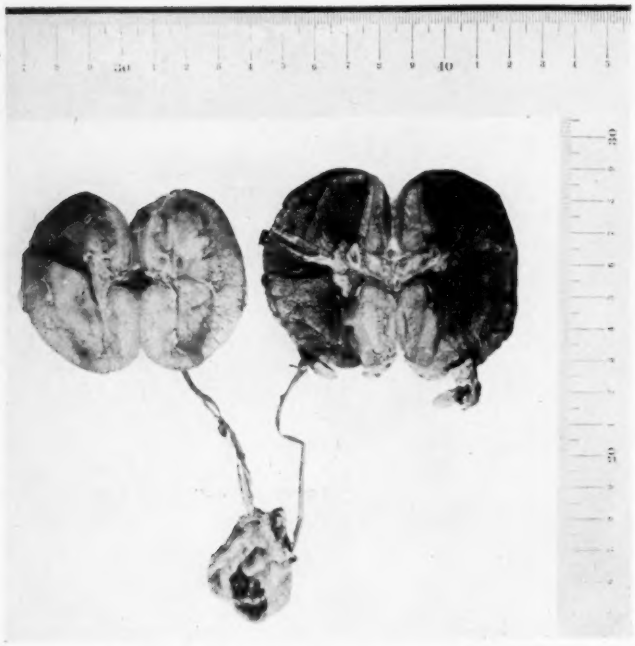

FIG. 3.—Dog No. 103. Hydronephrosis on right side following stripping of ureter; congested stage. Other kidney and ureter normal.

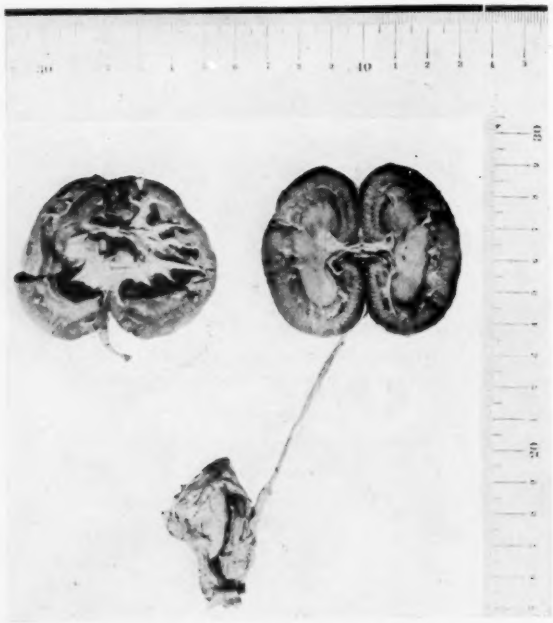

FIG. 4.—Dog No. 70. Hydronephrosis following stripping of ureter; dilated tubules stage. Other kidney and ureter normal.

FIG 5.—Dog No. 17. Hydronephrosis following stripping of ureter shown on left side; dilated tubule stage. Other kidney and ureter normal.

FIG. 6.—Dog No. 54. Hydronephrosis and hydro-ureter following stripping of ureter; advanced stage. Other kidney and ureter normal.

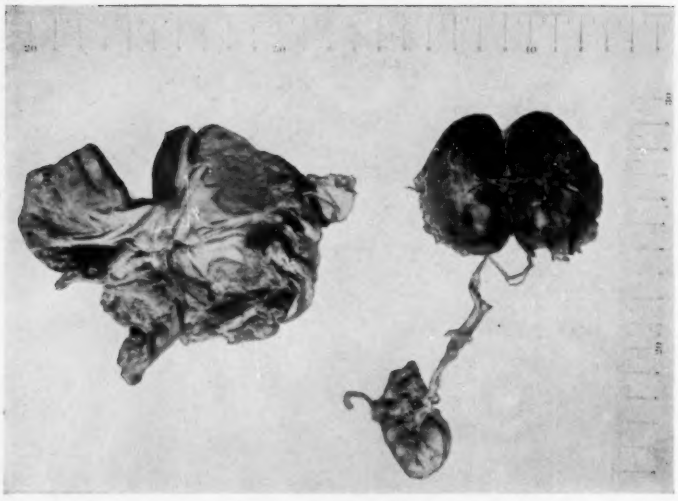

FIG. 7.—Dog No. 69. Pyonephrosis following secondarily infected hydronephrosis after stripping of ureter; terminal stage. Other kidney and ureter normal.

FIG. 8.—Dog No. 146. Hydronephrosis, both sides, produced on right by stripping of ureter and on left by ligation of ureter; congested stages. Notice perinephritic hemorrhage on left side.

FIG. 9.—Dog No. 129. Pyonephrosis following stripping of ureter and circumcision of ureterovesical valve; advanced stage. Other kidney and ureter normal.

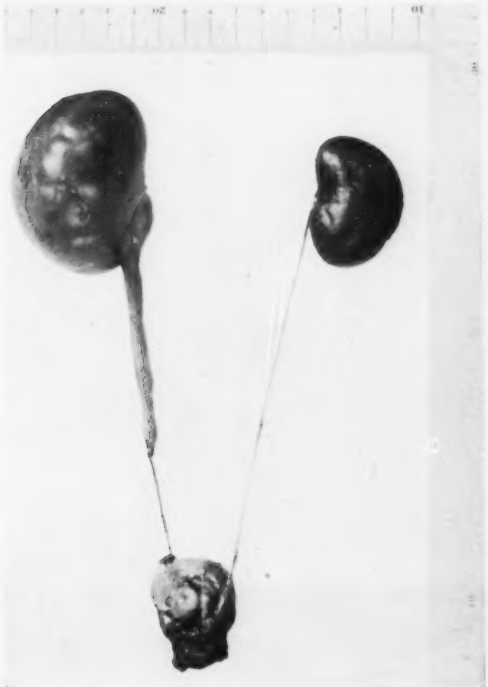

FIG. 10.—Dog No. 152. Hydronephrosis following ureteral calculus at junction of lower and middle thirds. Bladder shows vesical calculus.

FIG. 11.—Hydronephrosis following calculus at ureteropelvic junction of ureter. From clinical case.

FIG. 12.—Hydronephrosis following calculus at ureteropelvic junction of ureter. Showing cut section.

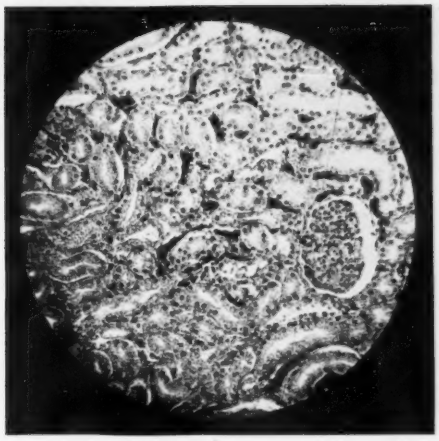

FIG. 13.—Dog No. 146. Showing intertubular and glomerular congestion occurring at the end of five days, following stripping of ureter.

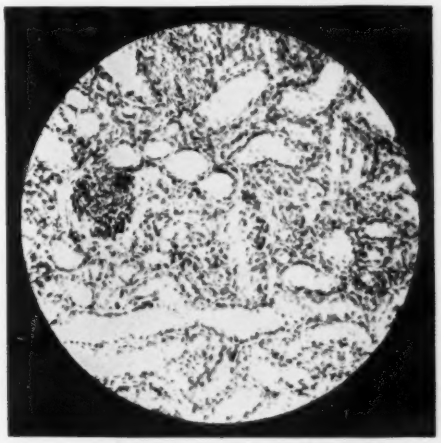

FIG. 14.—Dog No. 70. Showing dilated peripheral tubules from dilated tubules stage of experimental hydronephrosis.

Keen[16] and others enumerate tumors of the ureter and bladder among the causes of nephrectasia.

We offer for consideration the following: Physiologic or adynamic ureteral obstruction may give rise to distended kidney. To determine this we used dogs, after properly narcotizing with morphia and anæsthetizing with ether. In nine cases[18] the ureter was removed from its bed and stripped of every recognizable vessel nerve and fascial connection from kidney pelvis to bladder insertion, and in order to make sure it was absolutely freed from nervovascular connections through its course as well as to irritate the suppositional nerve plexus in the adventitia of the ureter, this organ was rubbed snugly with dry gauze throughout. It was then allowed to drop back into the abdominal cavity. In each case a cubical foreign body infected with autogenous colon bacilli and other organisms, and of such shape as not to cause valvular urethral obstruction as suggested by Draper and Braasch, was placed in the bladder through a mesoventrad incision, so that, as subsequent examinations of urine and bladder revealed, a permanent purulent cystitis was produced. The results were as follows:

TABLE II

SHOWING EFFECT OF STRIPPING URETER[18]

Case No.	Gross Findings	Microscopical Findings	Cause of Death	Condition of Ureter	Bacteriological Findings	Days of Life
103	Hydronephrosis	Congestion	Intussusception	Patent	Coccus colon-like organ	7
70	Hydronephrosis	Dilated tubules	Hydronephrosis	Stenosed	Coccus colon-like organ	21
17	Hydronephrosis	Dilated tubules	Hydronephrosis	Patent	Coccus colon-like organ. No change in fixation test for colon	31
54	Hydronephrosis; hydro-ureter	Nephritis	Hydronephrosis	Patent	Culture omitted	25
69	Pyonephrosis	Purulent nephritis	Pyonephrosis	Stenosed	Coccus colon-like organism	29
21	Normal	Glomerular congestion	Perforation of bladder	Patent	No change in fixation test for colon	24
22	Parenchymatous degeneration	Parenchymatous degeneration	Peritonitis (technical)	Patent	No change in fixation test for colon	8
24	Interstitial nephritis	Productive nephritis	Pneumonia	Patent	Culture omitted	121
100	Hydronephrosis	Nephritis	Hydronephrosis	Stenosed	Culture	69

In each of the three cases designated " stenosed " the obstruction appeared to be organized blood within the ureter. Wagner, referring to his clinical case, alluded to intra-ureteral hemorrhage following traumatism. Blood is allowed to remain, coagulate, and be organized because of ureteral paralysis and is, in our opinion, coincidental rather than causative in the development of hydronephrosis.

To study the physiological effect of such traumatism upon the ureter a dog was etherized to analgesia and the following observations made upon ureteral movements:

Case 160.—(1) Waves of ureteral peristalsis were noted at 9-second intervals. (2) Waves of ureteral peristalsis were noted at 16-second intervals with middle ureter stripped. (3) Waves of ureteral peristalsis were noted at 25-second intervals with greater part of ureter stripped. (4) Waves not continuous. Fibrillary contractions noted at 69-second intervals with ureter completely stripped. While at the same time waves of peristalsis were observed at 7-second intervals in normal ureter.

Case 161.—Case was similarly treated. Two ureters were exposed—one left intact, other stripped. On rolling normal ureter under finger contractions were elicited; on rolling stripped ureter under finger no contractions could be aroused.

From this observation it would appear that a cause of urinary stasis in the above experiments was ureteral paralysis. We, therefore, offer tentatively, and subject to further experimental proof as a cause of hydronephrosis, a ureteral condition analogous to adynamic ileus. It is true in several of the cases a mechanically obstructed ureter was found, but that such obstruction was irrelevant appears from a comparison of ten subsequent cases in which not one similarly obstructed ureter was found. These were cases in which the valve was cut and in addition, the ureter was stripped.

TABLE III

SHOWING EFFECT OF STRIPPING URETER AND CUTTING URETEROVESICAL VALVE[18]

Case No.	Gross Findings	Microscopical Findings	Cause of Death	Days of Life
74	Normal	Normal	Hæmoperitoneum	0
80	Congested	Glomerular congestion	Hæmoperitoneum	2
72	Pyelonephritis	Suppurative nephritis; abscesses; suppurative ureteritis	Pyelonephritis	7
77	Pyelitis	Congested parenchymatous swelling	Pyelonephritis	3
73	Pyelonephritis	Suppurative nephritis	Pyelonephritis(?)	23
89	Congested kidney	Parenchymatous degeneration; congestion	Pyelonephritis	20
88	Parenchymatous degeneration	.....	.....	11
83	Pyelonephritis	Suppurative nephritis; abscesses; tubules distended with pus cells. Glomeruli free	Pyelonephritis	13
81	Pyelitis; congested kidney	Glomerular congestion	.....	18
84	Chronic nephritis	.....	Ether	121

Histologically, the various changes in the kidney in experimental hydronephrosis have not yet been studied in sufficient detail to warrant more than passing mention at the present moment. The first step, however, appears to consist of widespread intertubular and glomerular congestion followed by granular degeneration and hydropic changes in

the epithelium, particularly of the convoluted tubules. At a later stage, corresponding to moderately advanced dilatation of the pelvis, the cortical tubules become markedly distended, their lining epithelium undergoes atrophy and the interstitial tissues begin to show the effects of compression. Finally, with increasing dilatation of the pelvis and obliteration of the calyces, the kidney tissue becomes noticeably compressed and its individual elements—tubules and glomeruli—atrophy. In secondarily infected organs the mucosa of the pelvis is replaced by a thick membrane made up of degenerated polynuclear leucocytes.

Clinically, one of the recent cases occurring in the practice of one of the authors (Stewart) typifies the hydronephrosis complex and emphasizes the important relationship existing between experimental and applied surgery. In this case there were found at operation a large hydronephrotic kidney and a calculus snugly wedged into the ureteropelvic isthmus of the cephalad ureter. Through the courtesy of Professor Douglas Symmers, to whom we are indebted for the microscopical study of our specimens, it was determined beyond reasonable doubt that the specimen was an adult kidney which had undergone pressure atrophy from the extreme distention of the pelvis and calyces. Experimentally a similar case was produced in one of our dogs, dog No. 152, by a calculus accidentally slipped into the caudad ureter to the junction of the lower and middle thirds. But these cases, alike in their gross and microscopical pathology, corresponded with the specimens produced by paralyzing the ureters. There may be a relationship between the ureteral calculus and the prostatic wave that is in its effect the same as an atonic ureter. Especially does such a possibility seem likely when as in our human case the calculus intervened between the pelvic and straight portions of the ureter, the point where, as described by Lucas [17] and observed by us, a change occurs in ureteral contractions and functions.

CONCLUSIONS

1. It is generally agreed that mechanical obstruction gives rise to urinary stasis and, when continued sufficiently long, to kidney distention.

2. This mechanical obstruction may be complete or incomplete, gradual or sudden. When the obstruction is sudden and complete transitory hydronephrosis with marked congestion follows. Atrophy intervenes and is proportionate to the duration of the obstruction.

3. Paralysis of the ureter is accompanied by urinary stasis and kidney distention in 66 per cent. of cases.

4. The pathological changes in hydronephrosis of functional origin correspond to the age of the adynamic ureter.

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PYELOGRAPHY IN THE DIAGNOSIS OF TRAUMATIC INJURY OF THE KIDNEY

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The symptoms present in traumatic injury of the kidney are more or less pronounced shock, pain in the lumbar region, particularly in the costovertebral angle, often radiating downward along the course of the ureters to the bladder, and genitals, hæmaturia of varying degree, rigidity and in severe cases temporary anuria on the side of the injury. If large amount of extrarenal hemorrhage, tumor mass in region of the kidney. Renal colic with cylindrical blood casts of the ureter are significant. Again there may be no bleeding if the ureter be torn across or if the laceration involves merely the fatty or fibrous capsule without crushing the kidney substance. While these symptoms determine definitely that the kidney has been traumatized, it does not tell us the amount or degree or character of the injury present.

Tuffier recognizes four degrees of injury. The first degree is characterized by subcapsular ecchymoses. When the violence has been more marked intrarenal blood extravasations are found most marked and constant at the base of the pyramids. In the third degree the capsule is ruptured; there is extrarenal hemorrhage, and deep, multiple stellate fissures of the kidney substance are produced, most pronounced about the hilum; sometimes they completely divide the kidney. Finally the organ may be reduced to a pulpy detritus.

Immediate operative interference is indicated only when signs of severe bleeding into the perirenal tissues, caused by rupture of the renal vessels, is present, or if the peritoneum is ruptured with severe bleeding into the peritoneal cavity; later, when symptoms of fever, tumor formation, increase of pain and high leucocyte count point to extravasation of urine into the perirenal space with infection and absorption therefrom.

Pyelography has been a valuable diagnostic aid in some of the surgical diseases of the kidney, as, for instance, hydronephrosis, pelvic dilatation from either ureter kink or nephroptosis, pelvic kidney, hyper-

nephroma, solitary kidney, hydro-ureter, localization of renal stone, and in exclusion for tumor differentiation.

To this list we wish to add its use in traumatic injury of the kidney, and we believe it to be a means whereby positive information can be arrived at and determine how much laceration has occurred to the kidney substance, whether it is an intracapsular injury or whether the capsule has been torn through by the dissemination of the collargol within the kidney substance or outside of it. Conclusions can be arrived at, then, whether surgical interference will be imperative without waiting for the above-mentioned secondary symptoms as an indication for such interference.

After active bleeding has ceased the bladder is thoroughly washed out and the cystoscope introduced. An idea of the functional activity of the kidney can be ascertained by the use of indigo carmine or phenosulphthalein intravenously, then the ureter of the injured side is catheterized and a 15 per cent. sterile solution of collargol very carefully and without undue force is introduced. Even while injecting the collargol, an idea may be gained, given a normal kidney pelvis, whether a great deal of laceration of kidney substance has occurred or if the capsule is torn through; this being determined by the amount of fluid that can be injected without giving the patient pain, it being a safe presumption that if more than 20–25 c.c. of collargol is used, that either there is great pulpification of the kidney substance or that the capsule is ruptured, thereby allowing dissemination into the perirenal space.

The character of the pain of which the patient may complain when sufficient fluid has been injected is not the characteristic colicky pain of an overdistended renal pelvis but a dull pressure pain referred to the lumbar region which occurs after considerable fluid has invaded the perirenal space.

Even before pain has been elicited back pressure upon the piston of the syringe gives the caution that the perirenal space which has been dissected up by the blood poured out following the injury is sufficiently distended.

The radiograph then taken will show either dissemination of the collargol within the kidney substance as in Fig. 3, or outside and in the perirenal space as shown in Figs. 1 and 2.

The first two cases here reported were admitted to the surgical service of Dr. W. H. Luckett at the Harlem Hospital with a history of injury sustained to the kidney, and acting upon his suggestion this method was used to determine of what aid, if any, it will be in the diagnosis of injury to the kidney.

FIG. 1.—J. N., aged forty. Rupture and laceration lower pole of right kidney. Fifty cubic centimetres 50 per cent. argyrol injected.

FIG. 2.—F. C., aged twenty. Complete laceration of one-fourth of lower pole of right kidney. 40 c.c. of collargol injected.

FIG. 3.—M. C., aged eleven. Showing dissemination of collargol in parenchyma.

In both cases the diagnosis of ruptured kidney has been verified by the radiographic findings before operation.

In the third case, a private one, Fig. 3, the picture shows what we take to be a dissemination of the collargol within the kidney substance only, and as the symptoms were of a mild character the probability is that the capsule was not torn, therefore there was no extravasation either of urine or collargol into the perirenal space. The pelvis and calyces in the three cases show moderate distention for the amount of fluid injected.

Case I.—J. N., aged forty years, admitted to Harlem Hospital, December 4, 1913.

History.—One hour before admission, patient fell from his wagon, the wheel crushing his right side.

Physical Examination.—Marked tenderness and rigidity on the right side of abdomen, especially in the upper quadrant, greatest tenderness in right lumbar region and costovertebral angle. Slight contusion of both thighs. Urine bloody; leucocyte count, December 7, 1913, 32,000; temperature range 101 to 103° before operation.

Cystoscoped by Dr. Friedman December 7, and 50 c.c. of 15 per cent. argyrol injected and radiographed (Fig. 1) by Dr. Wm. H. Stewart.

Operation and Findings by Dr. Luckett.—Mayo incision was made over right kidney, perirenal space found to be injected with argyrol; fatty capsule lacerated and macerated and entirely separated from the kidney; large pieces easily evacuated together with blood clots and pieces of kidney. The kidney was greatly lacerated, particularly at lower pole, so much so that its removal was deemed necessary. Wound irrigated and closed with cigarette drain at lower angle. Recovery marked by enormous discharge of the broken down perirenal fat.

Case II.—F. C., aged twenty years, admitted to Harlem Hospital, December 6, 1913.

History.—A few minutes before admission while driving a wagon was caught between a north and south bound car and thrown from his wagon.

Physical Examination.—Marked rigidity on the right side, upper quadrant of abdomen; marked tenderness in right lumbar region and costovertebral angle. Bloody urine. Leucocyte count, 17,000; temperature on the third day after injury 101° and ranged up to 105° until day of operation.

Cystoscoped December 10, and 40 c.c. of collargol injected and radiographed (Fig. 2) by Dr. Wm. H. Stewart.

Operation and Findings by Dr. Luckett.—Mayo incision was made over right kidney; upper pole normal, fatty capsule intact and adherent normally, lower pole about one-fourth of kidney found lying free with a fairly clean cut, very little laceration of the fatty capsule or remainder of kidney, so it was determined to remove only the free detached lower pole; wound irrigated and packed with iodoform gauze. Recovery uneventful. All blood disappeared from the urine on the twelfth day after operation. Cystoscopy on the twenty-first day after the operation—indigo carmine injected intravenously, appeared in

four minutes in the urine from both sides, thus showing the injured remaining three-quarters of the right kidney to be normally functionating.

CASE III.—M. C., age eleven, admitted to the Sydenham Hospital, January 7, 1914, under care of Dr. Friedman.

History.—While crossing the street was thrown down by a wagon, sustaining an injury to the back and sides.

Physical Examination.—Great tenderness in the left upper quadrant of abdomen and back, involving the left kidney region. Bloody urine. Temperature range during her stay at the hospital was 101°, the highest on the second day, and was normal on the fifth day. Leucocyte count on January 6 was 12,000.

Patient cystoscoped under anæsthesia by Dr. Friedman. Indigo carmine injected intravenously came through on both sides within three minutes. The left kidney then injected with 25 c.c. of 15 per cent. collargol and radiographed by Dr. Unger. Operation not indicated and patient left the hospital January 15. Urine was clear; feeling perfectly well.

X-ray also showed fracture of the eleventh rib, which did not give any subjective symptoms.

CONGENITAL MALFORMATION OF THE POSTERIOR URETHRA*

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This report concerns a case of congenital obstruction to urinary outflow due to an anomaly in development at the outermost end of the verumontanum.

J. M., aged three and one-half months, was admitted to the department of pædiatrics at Bellevue Hospital on July 30, 1913, as an urgent case. He had a temperature of 105°, and died a few hours after admission with œdema of lungs. The only history obtainable was to the effect that the child had been ill for a few days only, and the mother had noticed nothing unusual about its micturition.

Pathological Report.—The points of interest in the necropsy refer almost entirely to the genito-urinary tract, so the complete description is omitted.

The abdomen is distended. There is a hydrocele of the right cord. The peritoneal cavity is free from fluid or adhesions. There is a rather large fluctuating mass in the region of each kidney, the ureters being markedly dilated and tortuous. The bladder is distended and feels firm. The left kidney shows fetal lobulations and is much larger than the right, measuring 8 cm. from the upper to the lower pole. It is 3.1 cm. in width and 3.5 cm. thick. The pelvis of the kidney is so dilated that it considerably exceeds the kidney itself in size, measuring 4.5 cm. in width and 5 cm. from the edge of the kidney proper to its farthermost edge. The kidney has the appearance of a cap placed on a membranous sac and is very definitely distinguishable from the latter. On section it is observed that the kidney tissue varies in thickness from 1 mm. to 5 mm. and is seen to be flattened out into a shell, no sign of pyramids remaining, and occasional depressions are the only distinguishing marks of the calyces. The tissue of the pelvis is thinned out until it is of tissue paper thickness; the greatest diameter of the inside of the kidney and pelvis is 7.5 cm. There is a slight constriction which marks the beginning of the ureter. This measures 2.2 cm. in circumference. The capsule, which is rather thin, strips easily. The left ureter is enormous in size and markedly increased in length, measuring 13 cm. It is very tortuous and irregular in size at various points throughout its course. The average circum-

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ference is 3.8 cm. There is much folding, and the wall is, comparatively speaking, decidedly thin. The ureter passes obliquely through the bladder wall in the usual manner, and one is struck by its minuteness at this point, compared to the size of the structure elsewhere, because it can be penetrated only with a probe.

The right kidney shows fetal markings rather more pronounced than does the left. On the anterior and outer surfaces of the lower half of the organ, there are thirteen retention cysts, which vary in size from a pin head to 4 mm. in diameter. On the posterior surface at the junction of the middle and upper thirds, there is another small cyst which measures 6 mm. in diameter. The organ is 6.5 cm. in length, 2.8 cm. in width, and 2.6 cm. thick. The pelvis on this side is very similar in appearance to the one on the left, but is not proportionately so large. It measures 3.6 cm. from the kidney substance to the outermost portion of its circumference. It is 3 cm. in width. This organ, as does its fellow, bears a very close resemblance to a cap placed over a membranous sac which is the dilated pelvis.

On section the kidney cortex is found to vary in thickness from 1 mm. to 9 mm. The greater thickness at some portions is due to the fact that several prominent fetal lobulations are cut through. The entire anatomical arrangement of the organ is distorted, as in the left, the pyramids being entirely obliterated and an occasional depression marking the site of a previous calyx; a shell of kidney tissue of varying thickness is the impression one gets in examining the organ. On the outside of the thin pelvis are seen the veins and arteries coursing to the kidney proper. The greatest diameter of the inside of the urine-containing cavity is 4.7 cm. The beginning of the ureter is marked by a constriction and a slight folding of the mucosa. This measures 1.2 cm. in circumference, and is the smallest portion of the ureter above the bladder. On this side the ureter is much smaller, particularly in its upper half, where it averages 2 cm. in circumference. It becomes larger lower down, and at one point reaches a circumference of 3 cm. It is somewhat longer and more tortuous than its fellow, being 14 cm. in length. It shows the same extraordinary reduction in size as it enters the bladder.

Blood Supply.—Right kidney: An artery about 2 mm. in diameter is given off from the lateral surface of the aorta. It passes upward and backward, and before reaching the dilated kidney pelvis it gives off a branch which divides into three smaller ones and supplies a part of the upper pole of the kidney itself. The main trunk passes to the dilated pelvis, and there divides, one smaller branch running posteriorly between the kidney substance and the pelvis, giving off branches to both, and finally enters the kidney substance at about midway between the two poles. The larger branch passes anteriorly and, dividing into several smaller branches, becomes lost in the substance of the upper pole. A second artery, similar in size, comes off the aorta 7 mm. below the one just described. It passes almost horizontally outward, attaches itself to the anterior surface of the pelvis, where it divides into two larger branches and a smaller branch which supply the pelvis, and passing outward give off branches to the lower one-half of the kidney substance itself.

FIG. 1.—Normal bladder and kidneys of a 4-months-old boy (three-fourths natural size).

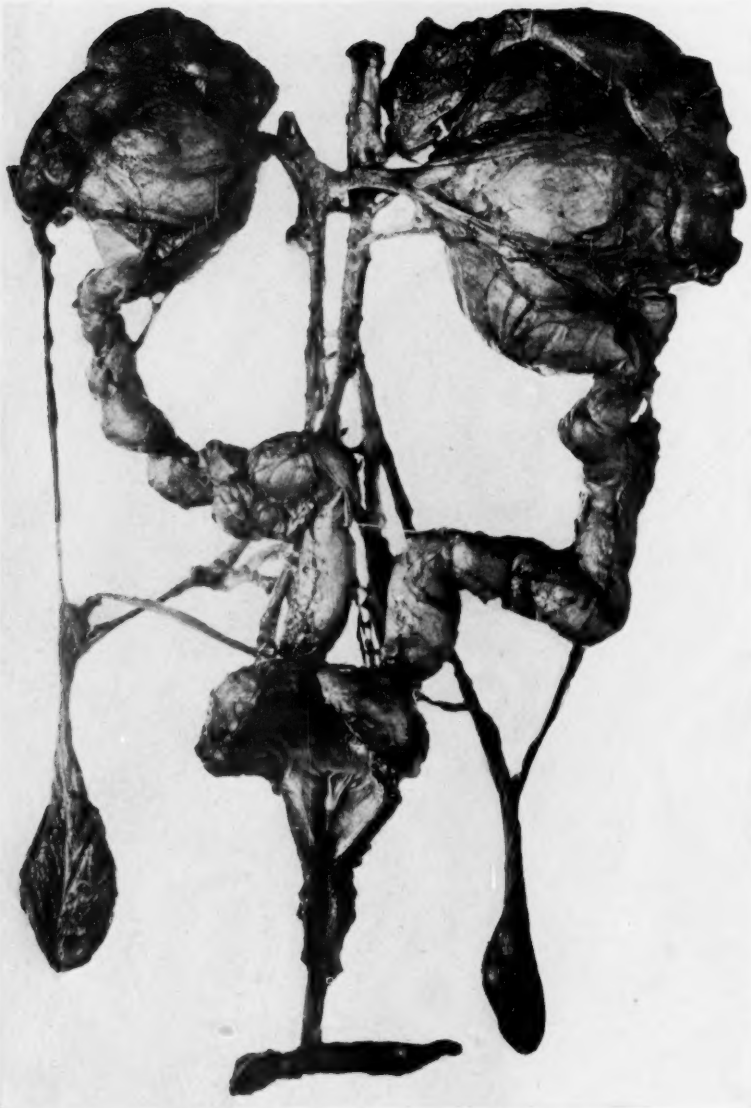

FIG. 2.—Anterior view of a case showing hydro-ureter and hydronephrosis, in a boy aged three and one-half months (one-half natural size).

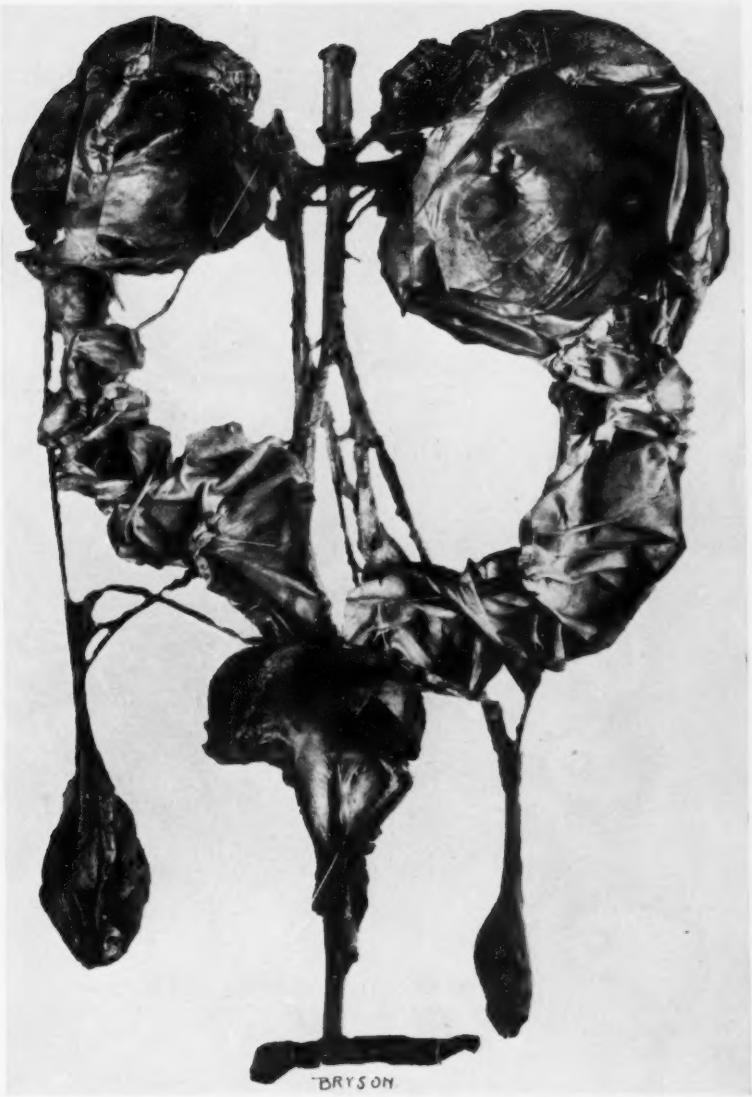

FIG. 3.—Same as Fig. 2, except that the ureters and kidney pelves are opened up and spread out, showing folds. There are probes in the ureters where they pass through the bladder wall. There is also a probe in the slit-like opening through the point of obstruction.

FIG. 4.—Posterior view, showing the left suprarenal gland and the arrangement of blood-vessels (one-half natural size).

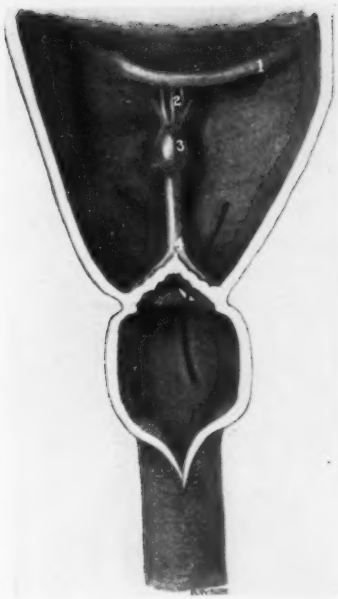

FIG. 5.—Diagram of posterior urethra. 1, lower end of internal (vesical) sphincter; 2, strands of tissue extending between trigonum vesicæ and upper end of verumontanum; 3, verumontanum; 4, lower end of verumontanum, showing the obstruction, with a small, slit-like opening on the floor to the left of the middle line. The urethra is laid open and shows a dilatation above and below the point of obstruction.

Veins accompanying this arterial supply, emptying into the ascending vena cava by four small trunks varying in size from 1 to 2 mm. in diameter.

Left kidney: The upper posterior half of the left kidney is supplied by an artery 1.75 mm. in diameter which arises from the lateral wall of the aorta about 3 mm. below the uppermost renal artery on the opposite side. This vessel passes outward until it becomes attached to the pelvis of the kidney 6 mm. from the kidney substance where it divides into two main branches, one of which passes down between the kidney substance and membranous pelvis, as far as the junction of the middle and lower thirds, and supplying both structures; the other passes directly to the upper pole where it subdivides and supplies this portion of the organ. A second larger artery, 2 mm. in diameter, is given off 4 mm. below, and considerably anterior to, the one just described. It passes outward to the pelvis and courses along its surface, finally dividing into branches which supply the anterior upper two-thirds of the kidney. A third artery, 1 mm. is diameter, passes horizontally outward, becomes attached to the pelvis and, traversing it, finally divides into branches which supply the lower one-third of the organ.

The veins of this organ are interesting, in that the blood of the entire structure is collected in vessels which accompany this unusual arterial supply, and unlike those on the opposite side, the veins here join at the anterior upper portion of the pelvis and empty into the ascending vena cava in one large trunk 1.7 cm. long after receiving a branch from the adrenal on this side.

The bladder seems to be about the usual size, but on section a most remarkable thickness of its walls is noted. This thickness is quite uniform over the entire organ and averages 8 mm. Throughout the entire fundus, there is noted a trabeculation with the formation of small cellules. The inter-ureteral ridge is present, but not marked, and the trigonum vesicæ is covered with a smooth mucosa, but is not particularly prominent. The ureteral orifices are slightly increased in size and their sphincters apparently obliterated. There is a ridge at the apex of the trigonum vesicæ which marks the site of the vesical sphincter. This latter structure is completely dilated so that the bladder and prostatic urethra are continuous and together form a funnel-shaped reservoir, the apex of which is found on a level with the apex of the prostate.

In the dilated posterior urethra are observed a number of prostatic duct openings. The verumontanum is peculiar in that six small bands are seen extending from the apex of the trigonum vesicæ to the largest portion of that structure where they seem to become imbedded in and form an integral part of it. At its widest portion, the verumontanum measures 3 mm. At this same point it is 3 mm. in height. At its lowermost portion, a particularly interesting arrangement is noticed. Ordinarily the verumontanum, which is formed by the ingrowth of the Müllerian and Wolffian ducts and their accompanying muscular coats, as described previously by the author,[1] becomes smaller and smaller at its lower portion where its fibres, about 1 cm. below its upper end in a specimen of this age, finally disappear by spreading out on the floor and

sides of the urethra in from 2 to 6 strands, some of which attach themselves to the walls. In this case some of the tissue of the verumontanum is disposed in the usual way, but a considerable portion of it continues down to the membranous urethra, where it divides into two portions and then attaches itself intimately to the entire urethral circumference with the exception of a very small slit-like opening on the floor of the urethra, just to the left of the median line which is lined with mucous membrane and could be penetrated with a fine probe.

The manner in which the division into two rather thick membranous bands occurs, and their attachment to the entire circumference of the urethra with the exception of a small aperture on the floor to the left of the median line, and also the fact that the entire structure is more or less dome-shaped, make the term "diaphragm," suggested by Dr. Hugh H. Young, seem most appropriate in referring to this anomaly. Almost complete obstruction to urinary outflow is caused by this unusual arrangement. Below the point of blocking, the bulbous urethra is considerably dilated.

There is a very large hydrocele of the right cord. Both testicles, the vasa deferentia, seminal vesicles, and the prostate are normal in appearance.

Microscopic Description.—Kidney: The section is a typical picture of compression of the kidney due to hydronephrosis. The kidney pelvis is surrounded by a thick wall of firm connective tissue in which are seen connective tissue cells with long, thin, darkly staining nuclei, whose long axes run parallel to the line of the fibres. Inside of this area there is a rather broad mesh-like layer of connective tissue in which there are large numbers of cellular fibroblasts and lymphocytes. There are also seen in this same area a great many eosinophile cells. The blood-vessels show rather thick walls, particularly the adventitial layers, and they are also congested. The straight tubules are atrophic and surrounded by connective tissue. The coiled tubules have disappeared in one portion of the section and are replaced by cellular connective tissue. Where they are present, their basement membranes are thickened by cellular growth. They show some cloudy swelling. The glomeruli are widely separated and greatly reduced in number. They show a rather thick capsule, and the glomerular coils have a marked increase in the number of endothelial cells. The interstitial connective tissue is everywhere increased and the picture has become, in the strict pathological sense, a chronic interstitial nephritis.

Ureter: The wall of the thinned-out ureter is lined by transitional epithelium which is very markedly diminished in thickness compared with the normal. The mucosa is composed of squamous cells, arranged in two layers, which are attached to a basement membrane. The submucosa seems to be thinned out in most places, and the muscular bundles are stretched out so that their long axis is in every case parallel with the axis of the ureter itself. There is a slight increase in connective tissue which is disposed between the stretched-out muscular elements, and there are many newly developed fibroblasts seen.

The bladder wall is tremendously thickened, and on microscopical

examination it is observed that there is an increase in all the elements composing the structure. The muscle bundles are much increased in size, and not only do there seem to be a great many more than the usual number of muscle fibres in the bundles, but the fibres themselves appear to be larger than the ordinary smooth fibres of the bladder. The connective tissue elements are also greatly increased. The intramuscular connective tissue bundles are large, and scattered here and there very frequently throughout the muscular bundles at their borders are seen collections of recently developed fibroblasts in nests or groups. There is a very abundant blood supply. The mucous membrane is of the usual transitional type. It is thickened as is the submucosa.

Urethra: The dilated prostatic urethra is lined with epithelium of the transitional type, resting upon a felt-work of fibro-elastic bundles under which is a thickened submucosa. The verumontanum is interesting, in that, by the use of Van Giesen's stain, it is observed that while there is a sprinkling of muscular elements throughout, it is at its lower portion made up mostly of connective tissue fibres. It is quite vascular throughout its entire length, the vessels being rather more numerous and considerably larger than is usually the case. Cross-section at the point of obstruction shows a very small slit-like lumen lined with stratified epithelium, resting on a felt-like base under which is a very thick submucosa. Surrounding this there is an exceedingly extensive area rather densely arranged made up of connective tissue and smooth muscle fibres. There are a number of dilated vessels quite thickly scattered throughout this tissue.

Discussion.—The case here described is very similar to the one described by Knox and Sprunt,[2] but considerably more pronounced. These writers made a very exhaustive study of the literature up to the time their article appeared, and found that while no reports on the subject were recorded in the American literature, a great many almost identical cases had been described in foreign journals: Wilckens,[3] Lederer,[4] Tolmatschew,[5] Bednar,[6] Godart,[7] Budd,[8] Velpeau,[9] Schlagenhaufer,[10] Commandeur,[11] Bonnet,[12] Teboul,[13] Fuchs,[14] Porak,[15] Lindeman,[16] and Picard[17] being among the number who had written on this subject. Bazy[18] observed six cases of congenital stricture in the region of the pars membranacea or pars bulbosa, in men and older boys, and emphasized the importance of congenital strictures even in adults. Ebert[19] punctured the obstructing membrane in a similar clinical case and discharged his patient as cured. Englisch[20] collected a large number of cases of congenital narrowing of the male urethra.

Recently, JORDAN[21] has published a case in which he found a stricture of the prostatic portion of the urethra in a boy about one year old, which measured one-quarter of an inch in length.

RIEDEL[22] has recently described nineteen cases of congenital stricture of the urethra that were treated in his clinic. Six of the nineteen died, a seventh

developed tuberculosis behind the narrowed portion of the urethra, but recovered. He considers it a relatively harmless developmental defect which only becomes serious when there is a considerable cutting off of the urethra, or when it is narrowed throughout its entire length. Dr. Riedel classified his cases as follows:

1. Contraction of the urethra behind the membranous portion.
2. Circumscribed area in front of the scrotum or an extensive network stricture at the perineum.
3. Stricture of the bulbous urethra.
4. Stenosis in front of external orifice and in perineum.

Henry Morris[23] quotes a number of cases of congenital obstruction observed by himself and other European surgeons. Lamotte relieved a case, in which a thin membrane situated at the vesical orifice of the urethra had caused hydronephrosis, by passing a sound.

Howship (*Treatise on Diseases of Urinary Organs*) has described three cases of imperforate urethra and Dr. Kennedy (*Dublin Journ. Med. Sciences*) exhibited to the Dublin Pathological Society the body of a new-born infant with enormous distention of the urinary organs, due to obstruction of the urethra. Dr. Morris describes a case in which the kidneys, ureters and bladder were greatly distended, the only ascertainable cause being a small cyst in the mucous lining of the membranous urethra. This cyst did not quite fill the lumen of the urethra, but, being situated on the floor of the passage, it formed an effective barrier to the outflow of urine.

Dr. Hugh H. Young,[24] of Baltimore, has had several cases of congenital obstruction at the posterior urethra, two of which were similar to the case here described and both relieved by passing sounds. Another one was of a recent type, at the vesical orifice, and another a very peculiar double urethra, both of which he operated upon through the suprapubic route.

This case seems to be an anomaly of the development of the Wolffian and Müllerian ducts rather than a defect in the urethra itself. These structures, which in the male become the ejaculatory ducts, and the utriculus prostaticus, enter the prostate near its base and course in an oblique direction through that organ until they approach the urethra, at which point they turn and for a short distance run parallel with its axis, finally opening into its lumen. During their passage through the prostate, their musculature is bound together by a very definite, firm sheath of connective tissue. On their approach to the urethra, they push the floor of that structure up into a mound, forming the verumontanum, and still are separate from all other structures, their tissues being superimposed upon those of the urethra. Ordinarily, immediately below the openings of the ejaculatory ducts and utricle, the tissues surrounding them become distributed among the fibres on the floor of the urethra. Thus the verumontanum gradually becomes smaller and smaller until just below the apex of the prostate it disappears completely, spreading out laterally in the form of little bands which dis-

appear on the floor or walls of the urethra. In the specimen under consideration, although a number of fibres are disposed in the usual manner, the majority of them continue downward on the floor of the urethra. At the point where the verumontanum usually disappears, these fibres attach themselves to the entire circumference of the urethra, with the exception of a small portion of the floor to the left of the median line, thus producing an almost complete blocking of the urinary passage.

The dilatation of the urinary tract must have begun in this case as soon as any considerable amount of urine was secreted by the kidneys. On account of the obstruction to urinary outflow, the bladder undoubtedly filled up, and its continual contraction, in an attempt to empty itself, caused the enormous thickening of its wall and, by hydrostatic pressure of long standing, dilated the vesical sphincter to such an extent that it became absolutely ineffectual, a small ridge being left to mark its site. The posterior urethra thus became cone-shaped and directly continuous with the bladder lumen. The fact that the bladder wall has developed such an extensive hypertrophy instead of undergoing a thinning out process with separation of muscular bundles and enormous dilatation of the bladder lumen supports strongly the idea that the process has been very gradual and of long duration. By continually working against a gradually increasing pressure, the muscular fibres have become larger, more numerous and more compactly arranged so that the bladder lumen is only slightly if at all dilated. By the great thickening of its wall, the bladder has held the ureters in their passage through almost down to their normal size, although even under these conditions they are somewhat dilated in their course through the bladder wall and their sphincteric control has been totally or partially lost. The ureters and the pelves of the kidneys apparently do not respond by an extensive thickening, comparatively speaking, or at least if they do so, at first the increase in pressure overcomes such thickening, and these structures, being architecturally less competent than the bladder and prostatic urethra, become enormously dilated and the ureters are markedly lengthened so that in order to be accommodated they are thrown into distorted curves and folds. No particular reason can be found for the fact that the right ureter and kidney pelvis are somewhat smaller in size, and the ureter a little longer than the left. Back pressure has also distorted the arrangement of the kidney tissue proper, so that the usual landmarks are not distinguishable, and microscopically that organ shows a chronic interstitial nephritis.

In hydronephrosis, we have the remarkable picture of an organ

secreting fluid under a gradually increasing pressure, produced by itself, which finally brings about its own destruction.

In children, a hypertrophied bladder wall with dilated ureters would seem to indicate a response on the part of the urinary tract to a gradually increasing obstruction of long standing, while a dilatation of the bladder, with thinning of its walls, is due to a more sudden and more complete obstruction to the urinary outflow.

It is rather difficult to explain why this particular anomaly should occur so frequently, as the point of obstruction in this and similar cases is above the junction of the pars membranacea and the pars bulbosa, which is the generally accepted [25] point of division between that part of the urethra which develops from the entoderm and that which is derived from the ectoderm. Felix [26] does not agree with the opinion expressed by Broman, but maintains that the entire urethra from the verumontanum outward is developed from the sinus urogenitalis and is of entodermal origin.

Undoubtedly, a great many of these cases have advanced to such a degree that there is very serious renal impairment at the time of birth, but since a number of them live for several years (Budd's patient was 16 years old; Lederer's 11 years; Wilcken's 2¼ years; Knox and Sprunt's case, 5 years), it seems most important to urge upon the medical profession that any children who show an urinary output below the normal, a dribbing of urine, abdominal masses in the kidney region, or other signs and symptoms pointing to a disturbance of the urinary organs, should have a thorough urethral exploration, and obstructions, such as the one here described, could be relieved by proper instrumental treatment.

This investigation was made in the Pathological Department of Bellevue Hospital.

The author expresses his most sincere thanks to Dr. Charles Norris, Director of Laboratory, and his assistants, whose generosity and assistance have made its publication possible, and to Dr. Hugh H. Young for many helpful suggestions. The illustrations were made in the photographic studio at Bellevue Hospital by Dr. Bryson, the Photographer to the Pathological Department.

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CIRCULATORY AND TROPHIC DISTURBANCES OF THE EXTREMITIES*

AN ATTEMPT AT CLASSIFICATION

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The mixed nomenclature and the confusion that exists in the description of various conditions involving the extremities produced by vasomotor, circulatory and trophic conditions have prompted the writer to attempt to straighten out in his own mind the different diseases. The reading of the literature proved so interesting and revealed such a quantity of controversy and faulty tabulation, that it seems to the writer it would interest and instruct others were these diseases divided into distinct classes as complete entities. It is with an apology that he offers nothing new or original, either clinically or in pathology, but simply a tabulation of the work of others.

The rarest of the diseases under discussion is erythromelalgia. This condition was first described by Weir Mitchell in 1872 [1] and in 1878 [2] he first made use of the term erythromelalgia, which means *red, painful limb.*

The disease is of rare occurrence, only about 150 being reported in the literature, some of which should be eliminated as belonging to other groups of the confused types. Up to 1909 only 3 cases had been observed at the Johns Hopkins, and Osler at that time had seen but one case in private practice.[3] It has been the writer's fortune to see but one case, and that a typical one.

The disease affects men and women about equally, according to Fossier, and is most frequent between the ages of 20 and 40. The parts involved are usually one or both legs, although the arms may be the seat of trouble alone, or all four limbs may be involved.

The initial symptom is pain, confined to a more or less clearly defined area. This pain persists for several hours and then subsides, only to return at fairly regular intervals. The pain is of a burning character, described by the patients as "hot coals," and in the more advanced cases is of an intensity beyond description. Warmth of any kind, even the lightest covering, increases the severity of the pain.

* Read before the New York Surgical Society, May 13, 1914.

Prolonged applications of cold, either ice or ice-water, soothe the suffering. Pain may be the only symptom in the early stage, but later on in all cases and in some at the very onset, the other cardinal symptom appears.

This is the characteristic reddening of the limb, which manifests itself whenever the limb is pendent, and speedily subsides on elevating the part. The change in color is a bright red, sometimes mottled, with swelling but no œdema, increased surface temperature, acceleration of the arterial beats in the limb, and distinct engorgement of the vessels and capillaries. Cassirer [4] divides the cases into two groups: 1. Where the pain and redness follow the distribution of some definite nerve trunk. 2. Where the entire distal portion of a limb is involved. Gangrene does not occur.

The pathology of this disease is most obscure, because none has been submitted to careful microscopic examination with conclusive findings. Lewin and Benda [5] up to 1894 had collected all the cases, 41 in number. They do not believe that it is a disease *sui generis*, but occurs in various cerebral and spinal maladies, in neurasthenia, hysteria, and as a manifestation of neuralgia and neuritis or as a reflex disease. Weir Mitchell does not think this suffices, and believes it to be a *neuritis of nerve endings*. Cassirer considers it to be a peripheral neuritis, where the lesion corresponds to a definite nerve distribution; but where an entire portion of a limb is involved he considers that the disturbance is one of the vasomotor centres.

The course of the disease is undeterminable. It may progress to a certain point and there remain stationary; or it may advance so far that the sufferer is completely incapacitated; or again the symptoms may subside. The treatment is most unsatisfactory. Cold applications soothe the parts. Fossier reports two cures from the heavy injection of cacydolate of soda. Vasomotor constrictors are of no avail. About every drug in the pharmacopœia has been employed.

The symptoms and pathology of *intermittent claudication*, as a disease in horses, was well known to the French veterinarians several years before the disease was described by Charcot in 1859.[6]

The name, intermittent claudication, which merely means intermittent lameness, is a very poor one, for it is not sufficiently descriptive. The title dysbasia angiosclerotica intermittens, as suggested by Erb, is a better one; but custom and priority prompt us to retain the former.

The characteristic symptom of the disease is the intermittent lameness. It appears only on exertion and varies with the severity of the

disease. After a short walk there is a gradual cramping of the muscles of the legs and feet, with increasing disability, which finally becomes so insistent that the patient must rest. After a few minutes of repose the cramps and disability disappear, and the patient can resume his walk. On renewing the exertion the cramps and disability return, requiring another period of rest. During an attack the limb or limbs involved are waxy in appearance, congested or mottled in color and decidedly cold to the touch. During repose, when no "attack" is present, the patient has no subjective or objective symptoms, save a diminished or, perhaps, absent pulse in the tibial or dorsalis pedis arteries. The picture of these symptoms is so striking that it would not be possible in a typical case to confuse the condition with any other, and it is only in the border-line cases that any doubt exists.

The pathology is some form of angiosclerosis, either as an obliterating endarteritis, calcification, arteriosclerosis, with or without a similar condition in the veins. The angiosclerosis may involve any group of vessels or be confined to the secondary or tertiary branches, or may involve the capillaries. If the obliterating process be more advanced, there may be some trophic changes, such as muscular atrophy. The nerves may degenerate from occlusion of the vasonervorum, or if the obliteration be very complete, we may have gangrene. The angiosclerosis is not sufficient to explain the cardinal symptom of intermittent claudication, for angiosclerosis of a marked degree can often be found in the vessels of the lower limbs where there has been no history of the characteristic cramps and disability on exertion. Hunt [7] says we must assume another factor and that is an inconstant vasomotor spasm. Hunt pictures the condition as one where the diminished calibre of the vessels serves to supply the part with enough blood during repose; but when the increased demand of exertion is made, a reflex spasm of the vasoconstrictors occurs, thus further diminishing the calibre of the vessels and restricting the blood supply.

It is not unlikely that a similar pathology exists in other groups of vessels and may account for angina pectoris and some intestinal disturbances.[8] There is another class of case where we find the muscular spasms on exertion, but without the peculiar waxy look and coldness of the limbs. Dejerine [9] describes several of these cases, and ascribes the cause to an endarteritis of the vessels of the spinal cord at some confined area. In these cases the lack of proper nutrition at the centre interferes with the proper muscular activity. In these cases there was no change from normal in the vessels of the limbs, and they were

cured, or greatly improved, by antisyphilitic treatment. These should not be confused with the intermittent claudication of Charcot.

Thus, we should limit our term intermittent claudication to those cases of angiosclerosis of the limbs where we have the cardinal symptom of the recurring lameness and diminished blood supply, and we must explain this muscular cramp as due to an inconstant vasomotor spasm.

Pain on walking is the only symptom in common between this condition and that first described, namely, erythromelalgia. The absence or diminution of pulse with pallor and coldness of the limb, as compared with the heat, redness and increased pulsations of erythromelalgia, should clearly differentiate between the two.

The commonest of the diseases under description is *endarteritis obliterans* or spontaneous gangrene. Buerger[10] has devised a far better name, and that is thromboangeitis obliterans. This disease attacks men much more frequently than women, is nearly always confined to early adult life and is especially common in young Russian Hebrews. The condition is usually confined to the legs, but may spread so as to involve the upper limbs.

Pain, cyanosis and gangrene are the principal symptoms. The pain is not always present, or it may be of great severity. As a rule, it comes on only upon exertion and disappears on rest, although not always. The cyanosis is present usually only when the limb is pendent, and disappears when the limb is elevated. When pendent, the limb is described by most writers as red or reddish-blue, but in all the cases that have come under my personal observation, would more nearly be defined as "dusky" in color. The pain, change in color and swelling may be confined to one or more toes or involve a greater area of the limb. There is absence of pulsation in the dorsalis pedis and posterior tibialis arteries, and sometimes even in the femoral. The disease progresses slowly until gangrene in one or more toes appears. Though the gangrenous areas be amputated, the disease and gangrene encroach on more and more territory until all of the limb has been amputated up to the point where the vessels are healthy. One case comes to mind where all four limbs have been mutilated. Buerger has conclusively shown that in these cases the lumen of the vessels is diminished—not as a result of a proliferation of the intima or media—but by a distinct thrombosis, usually of the arteries, though the veins also may be involved. The thrombosis begins distally and works up; it does not start in the capillaries or arterioles, but in the next higher groups.

The microscopic findings clearly separate this disease from inter-

mittent claudication, for in intermittent claudication we have an angiosclerosis due to proliferation of the intima and media as opposed to a thrombosis in thrombo-angeitis obliterans. Clinically we have, as guides for a differential diagnosis in thrombo-angeitis obliterans, the distinctly colored limb as compared with the waxy white limb of intermittent claudication. The pain is less cramp-like and not so amenable to elevation and rest of the limb, as in cases of intermittent claudication. Gangrene is the usual outcome.

Intermittent claudication and thrombo-angeitis obliterans are very easily confused and often described as the same disease, but it is my belief that they should be differentiated. Pathologically they are totally distinct, and it ought to be possible to distinguish them clinically in well defined cases.

In 1862 Raynaud [11] described the disease which bears his name, and in 1874 published further enlightenment on the subject. He gave the name "local asphyxia and syncope," with a secondary title of "symmetrical gangrene." As in erythromelalgia the pathology is only speculative, but we do know that there is no organic disease of the vessels producing a permanent diminution of their caliber. Raynaud's explanation, that the "cause of the symptoms is a vice of the capillary vessels," is the correct one.

The disease presents varieties or stages which may follow in order or may be confined to but one or two of the forms. The parts involved are any of the four extremities, together with the nose, ears or cheeks. The fingers and toes are the regions most frequently attacked, and the condition is very apt to be symmetrical in the more advanced cases, though this is not necessarily so.

The simplest stage is that of "regional ischæmia" or the stage of asphyxia without any cause (unless a slight exposition to cold be assigned), when a finger or group of fingers and toes suddenly become blanched, cold and numb. After a time ranging from a few minutes to even many weeks, the symptoms disappear and the part returns to normal.

An exceedingly mild and unimportant manifestation of Raynaud's disease is frequently seen in the so-called "dead finger." The left index is the most frequently involved, and the patient says, "After my cold morning bath my finger is white and numb and does not return to normal until the reaction from the bath is established."

Regional cyanosis or syncope is another stage. Here the affected parts become congested and reddish black, with sensations of cold

both objectively and subjectively. The return to normal occurs after a varying interval.

A third variety shows an engorgement of the part with heat and pain.

In any of the forms gangrene may supervene. The gangrene is usually superficial and involves small areas at the pulps of the fingers and toes, or about the roots of the nails. The gangrene which is of the dry variety is apt to be symmetrical, and affects areas previously involved by the vasomotor disturbances. After the gangrene is complete, the area sloughs away and the part heals kindly. The gangrene may be more extensive and involve a whole digit.

Pain is trivial or absent in the ischæmic and syncope stages, but, at or just before gangrene appears, the pain may be very severe, located not only in the areas involved, but radiating in all the limbs and is paroxysmal in character.

The disease may be continuous or intermittent (the latter the more frequent). Women are much more likely to be victims of this disease than men. The commonest age is about 25 years, although very young children (3½ years) have been noted.

The cause is a spasm of the arterioles or venules or both. Spasm of both accounts for the ischæmic type. Spasm of the arterioles alone explains the cyanotic type, on the principle of loss of *vis a tergo*. Spasm of the venules alone is the cause of the hot, congested form. The gangrene follows from the faulty nutrition. The vasomotor irritation is probably in the cord accounting for the symmetry. The cause of the vasomotor disturbance is probably reflex through the skin or internal genitals (uterus and ovaries).

We must differentiate Raynaud's disease from thrombo-angeitis obliterans by the diminished arterial pulsations and the progressive gangrene in the latter, and the transitory character of attacks in the former. We have difference in sex and race also as guides.

The exciting causes help to differentiate between intermittent claudication and Raynaud's disease.

Between the ruboric variety of Raynaud's disease and erythromelalgia, the diagnosis is more difficult, but in typical cases the symptoms in erythromelalgia appear and disappear, depending on the position of the limb, while in Raynaud's disease position plays no part. The pain in erythromelalgia is much worse, except as compared to the pain of Raynaud's just as the gangrene is beginning to be noted. The pain in erythromelalgia is confined to the affected limbs, whereas in Raynaud's several limbs are involved. In erythromelalgia gangrene

does not occur. Elsner [12] reports a case of erythromelalgia of the hand with later development of complete gangrene involving the distal phalanx of the thumb of the same hand, with superficial gangrene of the nose, ear and cheek. He believes he has a case of Raynaud's superimposed on an existing erythromelalgia.

Angioneurotic œdema is hardly likely to be confused with any of the preceding diseases, but may as well be briefly mentioned. This condition seems to be dependent on disturbances of the sympathetic system involving the vasomotor nerves. The characteristic and only marked symptom is an acute non-inflammatory œdema most frequently attacking the face, but often the extremities. The œdema comes out suddenly, without warning, and reaches its maximum in a few hours. There is no pain except from the rapid stretching of the parts and no discomfort except stiffness due to the presence of the swelling. The swelling is circumscribed and either dark red or waxy. The œdema rarely pits on pressure. The condition lasts for hours or days, and disappears as rapidly as it came on. One attack predisposes to another. There are no distinct pathological findings.

The absence of increased pulsation and temperature and freedom from severe pain should readily differentiate this condition from erythromelalgia, and it is not likely to be confused with any of the other conditions described.

Trophic ulcer is a gangrenous ulcer, the result of pressure on some part where the nutrition of the limb is deficient, owing to disease or injury to the nerve supplying the area in question. The condition may be produced by tabes dorsalis, or be dependent on the degeneration of a single nerve.

The usual site for such an ulcer is the ball of the foot. The ulcer progresses, destroying the deeper parts, and finally involves a joint or the bone. Rest of part tends to heal the ulcer, but renewed pressure invariably brings a recurrence. There is but little pain, especially in ulcer due to tabes. The condition is not likely to be confused with gangrene of intermittent claudication or thrombo-angeitis obliterans, or with Raynaud's disease.

The diseases described above have been given in their pure form and as typical examples. As such, there would be but little chance to confuse them and no excuse for this paper. But the border line or atypical cases are the ones that confuse, and these we can only classify by comparing them to some standard. If we have, therefore, established a series of complete typical pictures for comparison, the object of this paper will have been accomplished.

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CINEMATOPLASTIC AMPUTATIONS*

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It does not appear that amputation for cinematic prosthesis, according to the method of Vanghetti,[1] has received adequate attention in this country. This emboldens me to report two cases in which I have resorted to this procedure, though the report is necessarily incomplete as it has not yet been possible to secure a satisfactory prosthesis, though the patients have good motion in their stumps.

The design of the operation, briefly, is to construct one or more muscular or tendinous loops at the end of the patient's stump, so that the voluntary movements of these loops may be transmitted to the artificial hand. Many artificial arms are already on the market for use with ordinary stumps. In the case of one of those in most general use, the hand is opened by touching a spring with the other hand, and snaps shut again, into a fist, when the spring is released. Such a hand as this, as the manufacturers themselves are forced to admit, is useful for nothing more than "Sunday wear," as there is no voluntary grasp in the hand. A better type of artificial hand is one that secures its motion chiefly by means of straps passed around the patient's body, especially over the opposite shoulder. With one type of arm constructed on this principle, the patient is enabled, presumably only after long and constant practice, to perform almost any motion; and a patient with both arms amputated can dress himself, feed himself, and can make many graceful gyratory motions of little practical use. At the recent meeting of the International Surgical Society in New York City, opportunity was afforded to see a number of patients equipped with arms of this type; but on closer examination I found that while almost any motion was possible, with fingers, thumb, wrist and elbow, yet the grip was very weak (unless the hand was locked by a spring), so that no manual work was attempted. These men make their living advertising this particular make of artificial arm, as travelling salesmen; and probably could make as good a living with-

* Read before the Philadelphia Academy of Surgery, May 4, 1914.

[1] G. Vanghetti: Plastica e Protesi Cinematiche; Nuova Teoria sulle Amputazione e sulla Protesi. Empoli, 1906. Previous works by this author, on the same subject, had been published in 1898, 1899, and 1900.

out any artificial arm if they advertised some other article of merchandise.

But there are very many patients in the laboring classes who are unable to live by their brains, and are utterly incapacitated by the loss of an arm; the most they can do is to act as watchmen, gate-keepers, elevator men, etc. If, however, they could be provided with a hand movable at will and possessing at the same time a grip strong enough to wield

> "a shovel, a rake, or a hoe,
> a pickaxe or a bill"

or do other laboring, carpentering, masonry or painting work, their earning capacity would be considerably increased, even if it still fell short of the normal.

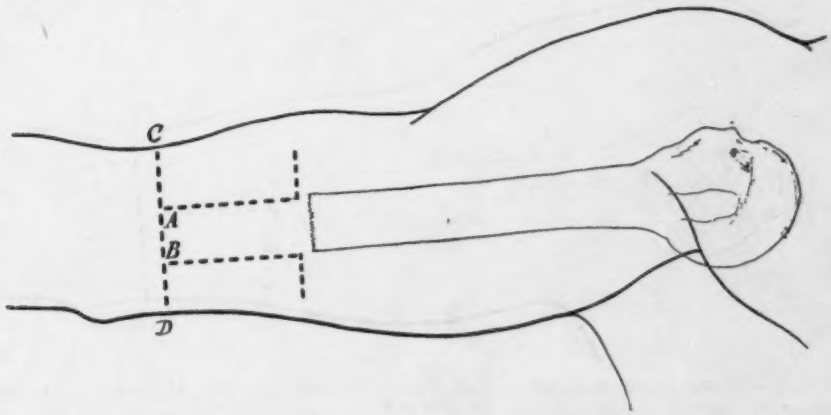

FIG. 1.—Cinematoplastic amputation. Inner surface of arm; the flap, *AB*, is to be used to cover the end of the bone; circular amputation at *CD*.

The amputation for cinematic prosthesis is a tedious operation and is not designed as a primary procedure in traumatic cases or in other patients acutely ill. The primary amputation in such cases should be given ample time to heal before the cinematoplastic amputation is undertaken. The level of bone section is determined by the length of the soft parts available for making the muscular loops; the latter should be amply long, so as to allow for subsequent retraction and nevertheless provide for plenty of play beyond the bone end.

In both the cases in which I have adopted this method, the amputation was done through the humerus, by the following technic (Figs. 1–4), which differs somewhat from that described by Vanghetti: a small skin flap is outlined over the brachial vessels, as long as the diam-

eter of the limb and nearly an inch wide, with its base at the level proposed for section of the bone (Fig. 1, *AB*); this flap is raised with the subcutaneous tissues, and the brachial artery and vein are ligated and divided just above the level at which the bone is to be sawed. The nerves are divided at the same level or higher, but great care is exercised throughout the operation not to interfere with the nerve supply of the muscles which it is proposed to utilize in the stump. A longitudinal incision is then made on the outer side of the arm (Fig. 2), between the flexor and extensor muscles, and these with the overlying skin are then raised from the bone, from the level of proposed bone section down as far as possible. In the arm the musculo-spiral nerve is now divided, unless it was accessible from the first incision. The soft parts are then divided circularly down to the bone

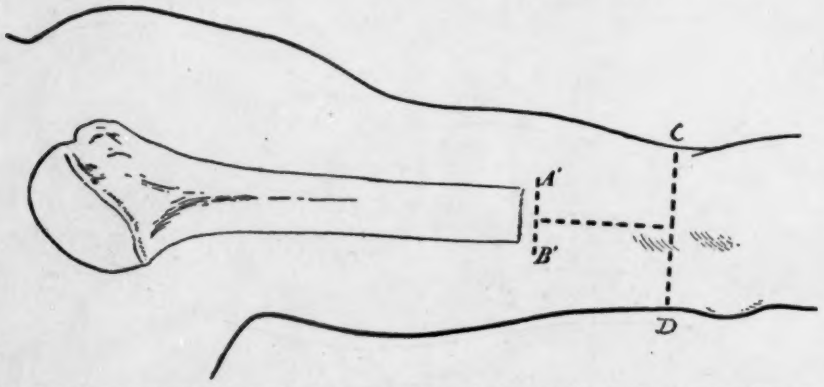

FIG. 2.—Cinematoplastic amputation. Outer surface of arm; the flap, *AB*, is sutured to the line *A'B'*.

at the distal limit of healthy tissues, and the musculo-cutaneous flaps are raised; the anterior flap contains the biceps (perhaps also some of the deltoid, brachialis anticus, or coracobrachialis, according to the level), and the posterior flap contains the triceps. The bone is then sawed at the desired level. A small transverse incision is then made towards the centre of the flexor and extensor flaps through the skin only, at their bases (Fig. 1), so as to permit of wrapping the skin around the biceps and triceps respectively, in the form of a cylinder. This little procedure when repeated on the outer side of the stump also leaves a free skin margin (Fig. 2, *A'B'*) to which may be sutured the end of the skin flap designed to cover the bone. This flap is next adjusted across the end of the bone, and is sutured in place with chromic catgut (Fig. 3, *AB* is sutured to *A'B'*). Absolute hæmostasis is important. Then the skin overlying the muscular flaps is wrapped around them in a cylinder, so

far as is possible (the skin usually is too scanty, and I had to sacrifice some of the muscle in both cases), and is sutured. Next, the free ends of the biceps and triceps are sutured to each other, end on, with buried sutures of chromic gut, and the remainder of the skin is finally closed as accurately as possible. A large rubber tube is passed through the loop thus constructed (Fig. 4), and the stump is lightly dressed.

CASE I.—Man aged thirty-five, a steam-fitter by occupation, was in Dr. Frazier's service at the Episcopal Hospital. Amputation was done, August 14, 1911, at the middle of the humerus

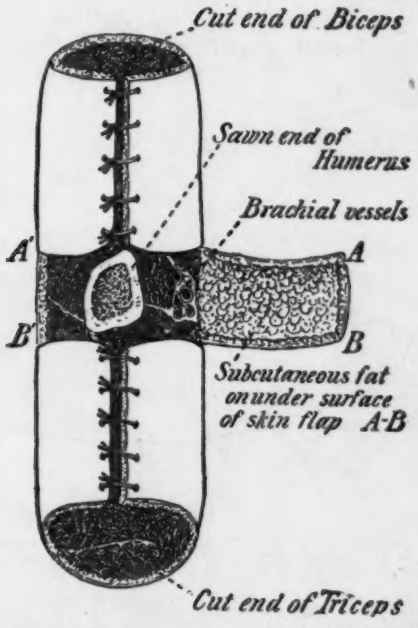

FIG. 3.—Cinematoplastic amputation. Diagrammatic view of the end of the stump. The flap, *AB*, is sutured to *A'B'*, and the skin overlying the muscular flaps is sutured around them as a cylinder.

for incurable infection of the hand and forearm, of nearly four months' duration. In this case the cinematoplastic amputation was done as the primary procedure. There was prolonged but not very active suppuration, due chiefly to an intractable dermatitis of the stump, which did not heal permanently until four months after operation. Fig. 5 shows his condition four weeks after operation.

As soon as healing was complete he left the city, and I did not see him for almost two years. In November, 1913, he returned to Philadelphia and I found his stump in very good condition. The flaps had retracted considerably, and the loop is now

about one-third smaller than shown in the photograph taken four weeks after operation. His stump is strong and freely movable voluntarily over the end of the humerus, and there is a direct pull of at least half an inch (1.25 cm.). He has surprising strength in the muscular loop, and if fitted with a proper prosthesis should have a strong grip in the artificial hand.

Case II.—Young man of twenty-one years, a painter by trade, whose arm had been amputated first for a crush at the age of fourteen years, at about the middle of the humerus. When nineteen years of age (in 1910) re-amputation had been done for a conical stump, the bone being divided this time through the insertion of the deltoid. Though this left a very short stump, it seemed that a cinematoplastic amputation should increase its

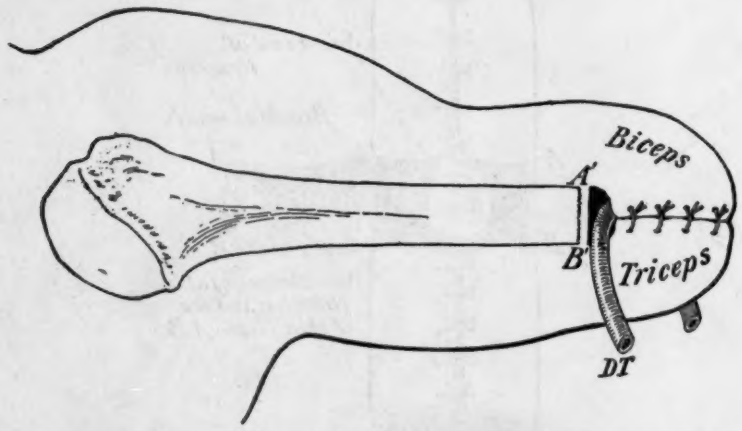

Fig. 4.—Cinematoplastic amputation. The biceps has been sutured to the triceps, and a rubber tube is passed through the loop before dressing the stump.

usefulness. The operation was done in Dr. Frazier's service at the Episcopal Hospital, on October 18, 1912. Healing was prompt and good power was secured in the stump, with nearly one inch of direct pull. The patient himself claims at least an inch and a quarter (3 cm.,) but I think this is an exaggeration. Fig. 6 is from a photograph made five months after operation.

This patient also was lost sight of for a long time, and only recently has he returned for observation. He has spent some time in jail, has neglected his stump, and thought the loop had closed up; but a strip of gauze was easily drawn through, though it caused a little bleeding, and a very slight discharge persisted as long as the gauze was kept in place. The stump is very strong, however, and the loop can be both flexed and extended very actively.

FIG. 5.—Cinematoplastic amputation: first patient; four weeks after operation.

FIG. 6.—Cinematoplastic amputation; second patient; five months after operation.

FIG. 7.—Cinematoplastic amputation; second patient; temporary prosthesis.

I myself and the patients themselves have consulted several manufacturers of artificial arms, with the object of having a cinematic prosthesis applied. The manufacturers invariably recommend and prefer artificial arms of their own manufacture and decline to manifest any enthusiasm about making artificial arms with a different mechanism. Finally I induced one manufacturer to make the attempt, but the patient then in question declined to pay for any "experimental" arm unless it proved absolutely satisfactory. This guarantee the maker declined to give, and the proposed deal fell through. This patient (Case I) then conceived the idea of making his fortune by inventing an artificial hand for himself, having it patented, then inducing some manufacturer to put it on the market and pay the royalties to him, while he himself would enjoy life travelling over the world as a sales-agent. Though he assured me he would send all the patients with arm stumps to me to have a cinematoplastic amputation performed, I have heard nothing further from him, and fear his scheme is not working out as well as he had anticipated.

Finally I determined to have a very simple apparatus constructed for the second patient, who was more tractable, and appeared to be willing to become the subject of experimentation. In default of any better contrivance, and purely as an experiment, I instructed Mr. Henry Saur of this city to make a pair of fingers, or finger and thumb in the form of pincers, attached to an arm socket, and worked on the principle of levers, by means of a cord which passes through the loop in the patient's stump. If this proves practicable, it can be extended to include more fingers or a complete artificial hand.

I may add that Vanghetti himself experienced very great difficulty in having a suitable prosthesis constructed, and the fact that he succeeded at last probably is due to his having as great a genius for mechanics as for surgery. However this may be, the various designs of apparatus which he gives in his book have not served to inspire any useful ideas in the mechanicians to whom I have submitted them. Hence I make this report of these amputations for cinematic prosthesis merely to show that the construction of the cinematoplastic stump is quite possible, and in the hope that someone with more mechanical ability than I myself possess will undertake the further problem of designing the prosthesis.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting, held at the New York Academy of Medicine, April 22, 1914

The President, Dr. Frederic Kammerer, in the Chair

GANGRENOUS APPENDICITIS IN AN INFANT TEN WEEKS OLD

Dr. Charles H. Peck presented a baby girl who, when ten weeks old developed a gangrenous appendicitis, for which operation was done January 27, 1914.

The baby reacted well and took nourishment for 48 hours, when persistent vomiting set in, lasting for twelve hours, and during the third and fourth days after the operation the child was in a critical condition. Improvement then set in, and from that time on its convalescence was uneventful. The drain was removed on the fourth day. The wound healed kindly, and there was no evidence at any time of an extension of the peritonitis.

PARTIAL GASTRECTOMY AND PYLORECTOMY

Dr. J. F. Erdmann presented a married woman, thirty-five years old, who had suffered for over two years with severe pain in the epigastrium, with pyrosis. She had lost 48 pounds in weight in less than two years, and was profoundly anæmic. The pain usually came on at night, about two hours after dinner, and was at times very severe, passing directly through to the back. There was occasional vomiting with the onset of the pain, with food contents of the last meal only. There was no history of blood in the vomitus. The patient could localize a certain spot where the passage of food gave rise to exquisite pain.

When this patient came under Dr. Erdmann's observation, on December 30, 1913, examination revealed a movable mass in the epigastrium, about the size of a small fist. On January 5, 1914, upon exposure of the stomach, a tumor was found involving the entire lower half of the stomach, necessitating a two-thirds excision of that organ. The glands were slightly enlarged.

Repeated examinations of sections of the large, fungating mass found in the removed specimen had failed to reveal any signs of malignancy. The patient had gained fourteen pounds in weight since the operation, and was at present in excellent condition.

PARTIAL GASTRECTOMY, PYLORECTOMY, CHOLECYSTECTOMY AND CHOLEDOCHOSTOMY

DR. ERDMANN presented a married woman, sixty-four years old, upon whom he had first operated three or four years ago, doing a right nephrectomy for a calculous hydronephrosis, and a right oöphorcystectomy, with appendectomy.

In June, 1912, she was again operated on for suspected gall-bladder trouble, and, upon exposure, a large carcinoma, involving the pylorus, was revealed. In addition, the gall-bladder was filled with stones, and numerous small calculi were found in the common duct. There was evident involvement of the neighboring glands.

A partial gastrectomy and pylorectomy were done, and, in addition, a cholecystectomy and choledochostomy. The patient made a rapid and uneventful recovery, and up to the present time showed no evidence of a recurrence.

EXTENSIVE GASTRECTOMY FOR ADENOCARCINOMA

DR. ERDMANN presented a man, thirty-three years old, who was operated on November 21, 1913, for obstruction, characterized by symptoms that were indicative of either ulcer or malignancy and rather pointing to the latter. Operation revealed an adenocarcinoma, with involvement of the glands, necessitating a gastrectomy, over five-sixths of the stomach being removed. Within a few weeks after the operation, the patient's weight had increased from 116 to 138 pounds, and up to the present time he had enjoyed excellent health.

DR. ERDMANN also presented a man, forty-eight years old, who came under his care on December 16, 1910, with the history of epigastric pain following the ingestion of food and at other times. The history dated back four months. There was a feeling of heaviness after eating, with belching, and he had noticed that certain kinds of food disagreed with him more than others. He had lost from ten to fourteen pounds in weight.

Examination revealed a markedly anæmic man, with a painful mass in the epigastrium. On December 20, 1910, a pylorectomy and partial gastrectomy was done, about five-sixths of the stomach being excised.

The patient made a good recovery from the operation, and on February 16, 1911, his weight had increased from 129 to 144 pounds, a gain of fifteen pounds. On December 20, 1911, his weight, which had been as high as 152 pounds since the operation, was 141 pounds. On July 7, 1913, he reported that he was in excellent condition, and

could eat anything without trouble. At the present time he showed no evidence of any recurrence, and his weight was 136 pounds.

PERFORATED GASTRIC ULCER

DR. ERDMANN presented a man, twenty-eight years old, who came to him on February 19, 1914, with the history that about six o'clock that morning he had a severe attack of epigastric pain, felt nauseated and perspired freely. Upon inquiry he said he suffered from abdominal cramps at various times. When Dr. Erdmann saw the patient, he presented evidences of shock, with marked abdominal rigidity and tenderness. A diagnosis of perforated gastric ulcer was made, and an immediate operation revealed a perforation on the lesser, anterior curvature of the stomach, with an indurated surrounding area the size of a silver half dollar. There had been some escape of gastric contents into the peritoneal cavity, and a large amount of exudate surrounded the ulcer. In view of the man's condition at the time, it was only possible to place a patch of gastrohepatic omentum over the perforation, and remove the appendix through a counter stab-wound, with drainage at the side of the ulcer. The patient made a good recovery and left the hospital in three weeks. Since the operation he had taken on about eight pounds in weight.

PERFORATED DUODENAL ULCER

DR. ERDMANN presented a man, forty-five years old, who was seen by him with Dr. MacKenty about 10.30 P.M. on November 5, 1913, with a history of having had previous gastric disturbances typical of duodenal ulcer. About three hours before Dr. Erdmann saw him he had had a sharp attack of pain in the abdomen, for which his family physician had administered one grain of morphine, without relief. The pain was limited to the epigastrium, and there was board-like hardness of the upper segment of the abdomen.

An immediate operation revealed a perforated ulcer in the first portion of the duodenum, and the abdomen was found to be filled with stomach contents. The ulcer was closed and inverted, and the appendix was removed through a counter stab drain opening.

The patient was discharged two and a half weeks after the operation. He was now in excellent health, and his weight had increased from 135 to 165 pounds.

PERFORATED DUODENAL ULCER

DR. ERDMANN presented a man, thirty-nine years old, who was first seen by him at 11 P.M. on March 17, 1914, with the history that

at two o'clock in the afternoon on that day he felt a slight uneasiness in the abdomen. Two hours later, after drinking a glass of beer, he was suddenly seized with a sharp pain, which persisted, so that he called in his family physician, who administered morphine.

When Dr. Erdmann saw the patient there was marked tenderness over the right upper zone of the abdomen, and upon inquiry the patient stated that he had had numerous attacks of indigestion, with pain in this area. The case was regarded as one of perforated duodenal ulcer, and at the operation, which was done an hour and a half later, a large perforation was found in the first portion of the duodenum. The peritoneal cavity was more or less flooded with a murky fluid. Excision of the ulcer was done, together with posterior gastro-enterostomy, and the appendix was removed through a counter stab drain wound.

The operative wounds in this case healed readily, but the patient's convalescence was marked by morning rises and evening falls in temperature, ranging from 103° in the morning to 100° at night. Physical examinations, blood counts, etc., revealed no cause for this temperature until about the sixteenth day after the operation, when the sputum showed numerous tubercle bacilli. The case was pronounced by Dr. Lambert as one of miliary tuberculosis, and the ultimate outlook was not encouraging.

PERFORATING ULCER OF THE DUODENUM

DR. ERDMANN presented a physician, thirty-three years old, who for a number of years had suffered more or less from intestinal disturbance, and who for the past two years had had definite symptoms, *i.e.*, pain, usually about three hours after eating, and occasionally at night. At one time, over a period of three days, his stools had been tarry. There was no history of vomiting or colic. He had lost about 30 pounds in weight during the preceding year.

Palpation revealed a tender spot in the region of Robson's point. An operation, done two weeks ago, showed an ulcer of fair size in the first portion of the duodenum. While attempting to excise the involved area, the ulcer ruptured. The excision was then completed, together with a gastro-enterostomy and appendectomy. In doing the gastro-enterostomy, two cysts were found on the convex surface of the first portion of the jejunum, one as large as a French pea, the other ten times larger. Both were excised.

The patient was discharged from the hospital in twelve days. He has since gained 25 pounds.

INDURATED PERFORATING ULCER OF THE DUODENUM AND PYLORUS; PYLORECTOMY

Dr. Erdmann presented a man, forty-nine years old, who was admitted to the medical service of the Post-Graduate Hospital on November 19, 1913, and transferred to the surgical wards on December 5 with the diagnosis of ulcer of the pylorus or duodenum.

Operation, December 5, 1913: This consisted of a pylorectomy, with posterior gastro-enterostomy. The patient made a less rapid recovery than in the type of non-excised ulcer, but his subsequent condition indicated a positive cure. He had remained entirely free from symptoms, and had shown a marked increase in weight.

DISLOCATED SEMILUNAR CARTILAGE

Dr. Alfred S. Taylor showed two cases where this injury of the knee had occurred. The first patient was a young man, who, while playing ball, gave his knee a sudden twist, and after this injury he had all the symptoms of a foreign body in the knee-joint. About a year ago he was operated on at the Fordham Hospital, where a foreign body, the size of a marrowfat pea, was removed from the upper half of the left knee-joint. There was no improvement after this operation, and as the joint still gave him constant annoyance, he returned to the hospital, where the condition was diagnosed as a probable dislocated semilunar cartilage. Upon exposure of the joint the cartilage was found split, with a small fragment wedged in between the joint ends.

Dr. Taylor's second case was one of hypertrophy of alar ligament of the knee, and upon exposure, the ligament was found considerably congested. The symptoms in this case were due to the presence of a small pedunculated enlargement of the fringe of the alar ligament, which was removed. Since then the patient had had no further trouble.

Dr. Howard D. Collins recalled a case where the semilunar cartilage was split longitudinally, and upon exposure, the torn cartilage presented the appearance of a button-hole. Probably, in the course of time this would have gone on to a condition similar to that described by Dr. Taylor. The speaker said that in cases where we had the characteristic symptoms of a dislocated semilunar cartilage, *i.e.*, pain and locking of the joint, the latter, upon exposure, should be carefully searched for adhesions of the ligamentum alaria.

Dr. Royal Whitman said he was a believer in the prompt operative treatment of dislocated semilunar cartilage, because after the dislocation had recurred several times, it was very unlikely that it could again become fixed. It was therefore practically a foreign body. The

speaker said he had removed the internal cartilage from both knees and both cartilages from one knee without any resulting disability. A very satisfactory method was to make a simple lateral incision with the knee flexed. In that position the cartilage could be readily removed by continuing the incision through it and separating its attachment to the internal lateral ligament. He was in favor of taking out the entire cartilage rather than the detached part. He called attention to the importance of the after-treatment of the weak feet, which he believed often predisposed to the injury and which, if uncorrected, would interfere with recovery.

DR. H. H. M. LYLE referred to the importance of inspecting the lower end of the femur in these cases, as it was often roughened. He recalled one case of dislocated semilunar cartilage in a base-ball player where, after removing the cartilage, the lower end of the femur was found to be so rough that it had to be chipped off. That patient had since been able to resume his place on the base-ball team.

In operating for dislocated semilunar cartilage Dr. Lyle always used the Robert Jones incision and has found it much superior to the ordinary vertical incision.

DR. F. W. KAMMERER spoke of several cases which he had operated on by a transverse incision. They had all done well. He especially mentioned one case, in which the middle portion of the internal semilunar cartilage had been torn from the capsule, the anterior and posterior ends having remained firmly attached to the tibia. Furthermore, the middle portion had been turned over so that it lay between the two condyles of the femur and was dislodged from this position with difficulty. It was then sutured to the tibia. The patient made an uneventful recovery and had no further trouble while under observation.

MULTIPLE BRAIN TUMOR

DR. CHARLES A. ELSBERG presented a man from whom he had removed two brain tumors. The patient was admitted to the New York Neurological Institute, in the service of Dr. Pearce Bailey, with the history that he had sustained a severe injury to the head twelve years before. For a year following the injury he had suffered from severe headaches, and had noticed a swelling of the skull in that region.

The only symptom shown by the patient at the time of his admission was a very marked disorientation. As soon as he left his room in the hospital he would be unable to find his way back, even if he stood just outside of the door. There was a marked swelling of the cranial bones in the parietal region near the median line, at the site of the former scalp wound.

At the first operation, about one year ago, the bone was removed over this region, and the dura exposed. The bone was very soft, about two centimetres in thickness, and so extremely vascular that the bleeding could only be controlled with difficulty. The dura underneath was much thickened, and the seat of a tumor formation.

At the second operation, done several weeks later, a piece of dura fully six centimetres in diameter was removed, together with two large, subcortical growths, each the size of an egg. These tumors were easily shelled out from underneath the cortex of the parietal lobe after the cortex had been incised. Both lay near the median line.

At the third operation an attempt was made to excise the diseased dura, but inasmuch as the tumor formation extended over the greater part of the falx cerebri and tentorium cerebelli, the attempt had to be abandoned. After the second operation, all of the patient's symptoms disappeared, and his condition seemed absolutely normal. He had remained so up to the present time, more than a year after the operation. The pathologist reported that the growths were endotheliomata, and that the dura was the seat of metastatic growths, while the process involving the bone was a rarefying osteitis.

Dr. Elsberg said the point he wished to emphasize in connection with this case was not the freedom from recurrence, but the fact that all of the symptoms had disappeared and the patient had remained well for one year, in spite of the fact that a large infiltration of the dura had not been removed.

BILATERAL PARALYSIS OF THE TRAPEZIUS MUSCLES AFTER NERVE DIVISION

Dr. Arthur S. Vosburgh presented a man, forty-five years old, with paralysis of both trapezii. The history obtained was that the patient had been operated upon seven years ago for tubercular cervical adenitis, and following this operation he noticed that his shoulder on that side fell forward and downward. Three years later he underwent an operation for a similar condition of the lymph-nodes on the opposite side of the neck, and this, too, was followed by a drooping of the shoulder. In addition to these operations, many minor operations were performed for recurrences and persistent sinus formation, as shown by multiple scars in the anterior and posterior triangles of the neck.

The paralysis in this case was limited to the trapezii muscles. The sternocleidomastoids were not involved, nor were the deltoids or serrati, and Dr. Vosburgh expressed the opinion that the paralysis in this case following the operative procedures, the one three years after the other, precluded the possibility of a lesion due to other causes.

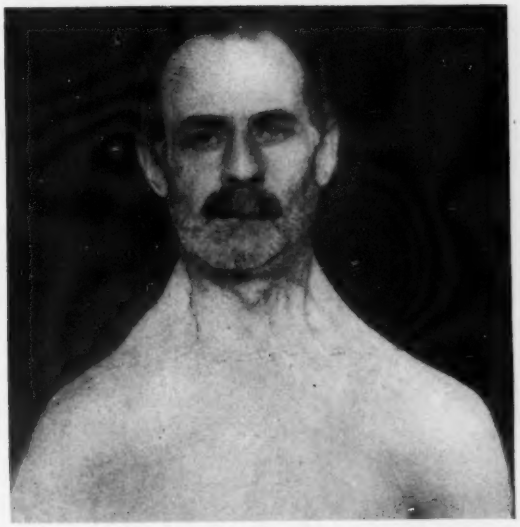

FIG. 1.—Paralysis of both trapezii from division of nerve supply.

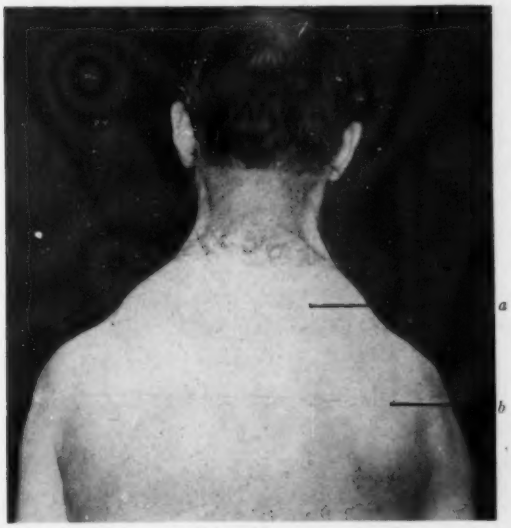

FIG. 2.—*a*, upper portion of thorax, rendered prominent by the falling downward and forward of the shoulder girdle; *b*, scapula, fallen forward and rotated downward.

DR. CHARLES N. DOWD referred to the relative importance of the spinal accessory nerve, and the branches of the cervical plexus in the innervation of the trapezius muscle. In a much used method of removing tubercular neck nodes the branches of the cervical plexus are sacrificed and only the spinal accessory preserved. In many instances this is sufficient to provide good innervation to the trapezius muscle. In other instances it might not be sufficient. He asked if any of the members present had found the eleventh nerve insufficient for this purpose.

DR. FRANK S. MATHEWS said he had seen the spinal accessory nerve accidentally divided and the injury not followed by shoulder drop.

DR. ELLSWORTH ELIOT said that some years ago he became interested anatomically in the spinal accessory nerve and the motor branches of the cervical plexus, and in a number of instances he found that the development of these nerves differed very materially. In some cases the termination of the spinal accessory passing to the trapezius branch was exceptionally well developed; in others it was not developed so well, while in rare instances it was entirely absent. Again, he had found that with a weak spinal accessory supply, the branches of the cervical plexus supplying the trapezius were exceptionally well developed, and *vice versa*. This might be accounted for by variations in the anastomosis between the spinal accessory nerve and the cervical plexus. In those cases where the spinal accessory supply of the trapezius was well developed, the degree of anastomosis between the cervical plexus and the spinal accessory was not well marked.

In operating on tubercular glands in the neck, Dr. Eliot said, he thought the spinal accessory should always be preserved, if possible. When its division was necessary, a neurorrhaphy could be done with very good expectation of reunion.

DR. ELSBERG asked Dr. Vosburgh whether a complete neurological examination had been made in this case. In many respects the case had the appearance of the Aran-Duchenne type of progressive muscular atrophy beginning in the shoulder girdle.

DR. VOSBURGH, in closing, said he could confirm Dr. Eliot's anatomical findings in this field, which were based by the latter on a very extensive experience in the dissecting room. The speaker said that he also had noticed that the nerve supply of the trapezius, which normally comes from both the spinal accessory and branches of the anterior divisions of the third and fourth cervical nerves, often formed a plexus formation, and the development or presence of the one was in inverse ratio to the presence or development of the other. That division of the spinal accessory alone was not, as a rule, followed by complete

paralysis of the trapezius. He recalled a recent case of tubercular lymph-glands in the neck in connection with an old sinus formation where the spinal accessory was involved in the cicatrix and was accidentally ruptured. It was sutured, and he hoped that the patient would suffer no ill effects from the injury.

Replying to Dr. Elsberg, the speaker said that from a rather brief review of the literature, he had gained the impression that the Aran-Duchenne type of progressive muscular atrophy usually occurred in young children, involving the shoulder girdle and generally the deltoid and the serrati. Here, these muscles were not involved. The duration of the paralysis in this case, too, militated against that diagnosis.

HAIR-BALL IN THE STOMACH

Dr. Walton Martin presented a woman, twenty-four years old, who was admitted to the hospital on April 1, 1914. The patient had been an inmate of a public institution and was rather dull mentally. The history obtained was that she had been troubled with nausea for three weeks, the attacks occurring two or three times daily, usually before meals and lasting for ten or fifteen minutes. There was no history of pain, vomiting nor eructations of gas. The appetite was poor; there had been some constipation, and frequent, severe headaches.

When the patient was admitted to the hospital she presented the appearance of a poorly developed and poorly nourished woman. She was rather nervous, but did not look ill. Upon examination, there was slight tenderness and rigidity from just below the ensiform cartilage to one inch above the umbilicus, and a short distance below and to the right, between the costal margins, there was a hard, somewhat nodular tumor, slightly tender and freely movable in all directions. She was given a bismuth meal and a series of X-ray pictures were made by Dr. L. T. LeWald. His attention was arrested by the peculiar way in which the stomach outline was evident after most of the bismuth meal had passed out of the stomach; he was struck by its similarity to a case reported by C. Thurston Holland in the *Archives of the Roentgen Ray*, March, 1914, and upon these findings he made a diagnosis of hair-ball in the stomach.

When Dr. Martin opened the abdomen, the stomach was found to be moderately enlarged, on a level with the navel. When opened, the stomach was found to contain a complete cast made up of hair, coated with bismuth. This was removed, and the gastrotomy and abdominal wounds closed. The patient made a normal convalescence and left the hospital in three weeks' time. She admitted that she had been in the habit of occasionally plucking a hair from her head and swallowing it.

FIG. 3.—Hair-ball removed from the stomach.

Dr. Martin said this case was of interest because the diagnosis was made by the X-ray prior to the operation. There were two other cases on record in which the diagnosis was thus established.

Up to October, 1913, the records showed 35 cases of gastrotomy for the removal of hair-balls from the stomach, with no fatalities.

BILIARY SURGERY: WITH AN ANALYSIS OF 270 OPERATIONS

Dr. JOHN F. ERDMANN read a paper with the above title for which see page 665.

Dr. ROBERT T. MORRIS said he had removed the gall-bladder in many of his cases. In those cases where it was permitted to remain, the question arose why, with the original conditions persisting we did not have a recurrence more often than was actually the case? One explanation was that following such an operation, the presence of drainage apparatus caused an interstitial fibrinous deposit in the walls of the gall-bladder, with subsequent contraction, so that in these cases, after drainage, the gall-bladder seldom returned to its original dimensions.

Dr. CHARLES H. PECK said that while he did not have the exact figures at hand, he was under the impression that in over fifty per cent. of the biliary cases where he had been called upon to operate, he had done cholecystectomy. When the walls of the gall-bladder were apparently normal, he limited himself to cholecystostomy, but when they were evidently diseased, he thought a cholecystectomy preferable.

Speaking of the re-formation of biliary calculi, Dr. Peck said he had recently done the third operation on a patient for recurrent stone. Six years ago this patient was first operated on for biliary calculi, and the gall-bladder, containing stones, was removed. Two years ago the common duct was opened, and a number of stones removed, and recently, Dr. Peck said, he had opened the common duct for a recurrence of symptoms, and had found it filled with inspissated bile and a large number of stones. The walls of the duct were much thickened, and that patient would doubtless have a further recurrence. In another case, where he did a cholecystostomy, with the removal of about 60 good sized stones from the gall-bladder, and a choledochostomy, with the removal of 12 large stones from the common duct, the patient, within one year, was obliged to submit to a second operation for the removal of stones in the common duct. These had either re-formed during this interval, or else had escaped a very careful exploration made at the time of the original operation.

Dr. GEORGE WOOLSEY thought that secondary operations on the gall-bladder and ducts were among the most difficult that the surgeon had to do in gall-bladder surgery. In all of the cases where he had been

called upon to operate for a recurrence of symptoms, he was inclined to believe that the stones were left behind at the primary operation, and that they were not newly formed stones.

It is an easy matter in these cases, Dr. Woolsey said, to overlook the presence of small stones unless the finger was introduced and the gall-bladder or duct carefully explored.

Dr. Robert H. M. Dawbarn said that a few years ago he saw a middle-aged woman at the Ossining Hospital, who was suffering from gall-stones, her gall-bladder being very large and distended; and he made preparations to operate on her on a certain date. On the very night before the day set for the operation, while the patient was lying quietly in bed, trying to go to sleep, she felt a sudden, severe pain in the region of the gall-bladder, and quickly showed symptoms of mild shock. When Dr. Dawbarn opened the abdomen, he found at least fifty gall-stones in the peritoneal cavity, dispersed everywhere by peristalsis, among the bowels. These were removed, together with the gall-bladder, which had a tear, five inches long, involving practically the entire length of it, and already showing signs of healing edges. This curious specimen he has saved. The patient made a good recovery.

There were five species of mammals, Dr. Dawbarn said, that have no gall-bladder, namely, the horse, the elephant, the ass, the rhinoceros and the true deer. In spite of its absence, the late Dr. Nicholas Senn had reported cases seen in India during his trips around the world, where elephants died from gall-stones or disease of the liver produced by such stones in the liver substance.

Dr. Charles N. Dowd referred to the effect of cholecystitis upon the pancreas. A persistently inflamed gall-bladder might lead to pancreatic inflammation as had recently been recorded both by Doctor Mayo and Doctor Deaver, he had personally observed this sequence. The danger of this occurrence frequently made a reason for cholecystectomy.

Stated Meeting, held at the New York Academy of Medicine, 17 West Forty-third Street, Wednesday, May 13, 1914

The President, Dr. Frederic Kammerer, in the Chair

SERIAL PLICATION OF A LARGE VENTRAL HERNIAL SAC

Dr. Robert T. Morris presented a woman, fifty-four years of age, who had a post-operative ventral hernia hanging below the pubes. Two unsuccessful operations had been done previously in the case. After freeing the skin Dr. Morris examined the contents of the sac through

a small opening. Adhesions of the viscera were so extensive that it was feared that separation of loops of bowel from the walls of the sac would endanger its vitality. Serial circular plication of the sac was then made with kangaroo tendon. Each suture encompassed an area about three inches in diameter. Six such sutures applied consecutively reduced the diameter of the sac about eighteen inches, leaving its surface on a plane with the normal abdominal wall. The wound healed by primary union, although the patient had 5 per cent. of sugar in her urine before going upon antidiabetic diet in the hospital. She would have to be fitted with a supporter. Inversion of the sac with its adherent viscera had not resulted in any interference with bowel movement in this particular case.

HABITUAL DISLOCATION OF THE PATELLA

DR. CHARLES A. ELSBERG presented a patient upon whom he had operated for habitual outward dislocation of the patella. The patient had been incapacitated for work and was unable to walk, because at each attempt at flexion of the knee, the patella would slip outward, and the patient would fall to the ground. The operation done was that recommended by Krogius a number of years ago. This consists of transferring a flap of the vastus internus muscle from the inner side of the thigh to the outer side, implanting it in an incision in the vastus externus. By this means the structures to the inner side are shortened, and those to the outer side lengthened. The result in this patient, operated upon eight months ago, was very satisfactory. On flexion of the knee the patella remains in its place on the condyles and the patient has regained full power over her limb.

MULTIPLE LYMPHOSARCOMA OF BOTH BREASTS

DR. ELSBERG presented a patient upon whom he had operated for multiple round-cell sarcomata of both breasts. The patient had been nursing a child for eight months and six months before multiple tumors appeared in both breasts. These enlarged rapidly so that when the patient first entered the hospital both breasts were much enlarged and filled with tumors of various sizes. The operation consisted of subcutaneous extirpation of both breasts, and the patient was presented to show how small a deformity was left after such subcutaneous breast extirpation. The glands in the axillæ were not affected. The pathological report was round-cell sarcoma.

TRANSFRONTAL OPERATION FOR TUMOR OF THE HYPOPHYSIS

DR. ELSBERG also presented a patient upon whom he had done transfrontal operation for tumor of the hypophysis. The patient was a

young girl whose menstruation had ceased a year before, and who had complained of increasing difficulty in sight. When she entered the hospital the left eye was absolutely blind, and there was temporal hemianopsia on the right. She had been operated upon twice by the transphenoidal route without benefit to her eyes. Through the transfrontal method described by the author, the hypophysis was exposed and part of a soft vascular tumor removed. The pathological report is fetal adenoma. Convalescence was uninterrupted. At the present time the pupil of the left eye again reacts to light and the patient has regained light perception in that eye, while acuity of vision in the right eye is much improved and the field of vision considerably enlarged. Patient was presented six weeks after her operation in order to show how slight the disfigurement was after this method of operation.

TRANSFUSION FOR POST-OPERATIVE HEMORRHAGE IN CASE OF OBSTRUCTIVE JAUNDICE

Dr. E. H. Pool presented a woman thirty-eight years of age, who, last spring, about seven months before the operation, had suffered from septicæmia, the infection originating in the throat; her blood repeatedly gave pure cultures of streptococcus. She received frequent doses of autogenous vaccines and also antistreptococcus serum prepared by Dr. Krumweide, of the Board of Health, who also made the cultures from her blood. After a prolonged illness with numerous complications, she recovered. The details of this illness have been reported by Dr. N. B. Potter and Dr. Krumweide. About the first week of October, 1913 (as nearly as can be determined), she developed jaundice which became extreme. Dr. Pool saw her later with Dr. Potter; her symptoms indicated a stone in the common duct. Fear of anaphylaxis, on account of the previous serum treatment, deterred Dr. Pool from administering serum as a prophylactic measure prior to operation, but she received calcium lactate for five days.

The patient was operated upon on November 3, 1913. Several stones were removed from the common duct. The possibility of post-operative hemorrhage was realized and consequently unusual care was exercised to secure absolute hæmostasis.

On the second day after operation fresh blood was noticed on the dressing. The bleeding continued freely. The sutures were removed and the superficial parts of the wound inspected, with the intention of trying to find and secure the bleeding vessels, but it was found that a general oozing was taking place from all cut tissues. On the evening of the second day the patient went into collapse and an infusion was given with only transitory improvement. Dr. Welsh administered

human blood serum at 9.30 P.M. and at 2 A.M. The following morning the patient vomited a large amount of bloody fluid; bleeding from the wound was active; the coagulation time was fifteen minutes; hæmoglobin 40 per cent.; red cells, 2,700,000. At noon (third day) a transfusion of 380 c.c. was given by Dr. Lindeman. That evening the coagulation time was six minutes, the bleeding less, and the condition of the patient improved. The next morning the dressings were again saturated with blood and the coagulation time was eight minutes. That afternoon another transfusion was given of 220 c.c. The following morning the coagulation time was three and one-half minutes, the bleeding had stopped and the condition of the patient was much improved. Bleeding, however, recommenced and the condition gradually became worse, and the patient was in very poor condition two days later (the seventh day after operation), when the coagulation time was twelve minutes, hæmoglobin 35 per cent., red cells 1,800,000. A transfusion of 900 c.c. was given and the patient's condition again improved. The next day the coagulation time was five minutes, hæmoglobin 46 per cent. The bleeding was permanently stopped and the patient made an uninterrupted recovery and was discharged on the twenty-seventh day.

In all three transfusions the patient's sister was the donor. Attention was called to the marked change in coagulation time following each transfusion and the diminution or cessation of hemorrhage coincidently with and roughly in proportion to the shortening of the coagulation time.

SPLENECTOMY FOR BANTI'S DISEASE. ANTE OPERATIVE TRANSFUSION

DR. E. H. POOL presented a woman thirty-nine years of age, who was admitted to the Medical Service of Dr. William Williams at the New York Hospital on February 4, 1914, complaining of weakness and a mass in the abdomen. She had come to this country three months before admission. On the voyage she was very seasick and vomited frequently, the vomitus on several occasions containing considerable blood. She also noticed that her stools were very dark. For the last three or four months she had been losing in strength and had felt too weak to work. She had noticed no change in the color of the skin, had no pain, and no headache. Her bowels were regular and she presented no urinary symptoms. For nearly twenty years she had had a large mass in the left side of her abdomen which had been increasing gradually in size but had never caused her pain or discomfort, or interfered with her leading an active life. No one else in the patient's family had had splenic enlargement so far as could be

ascertained. The patient had never had an acute illness, but had worked for the past twenty-five years as a laborer in the fields in Italy. She had never had malaria.

At the time of admission to the hospital the patient was poorly nourished, looked anæmic, had a yellow-ivory colored skin and yellowish sclera. Pulsation was visible in the veins of the neck. The pulse in the radials was equal, regular, small, and of poor force and tension. There was no sclerosis. The apex beat of the heart was three and one-half inches to the left in the fifth space; the right border of the heart was one-half inch to right of sternal line. At the apex and base there were fairly loud systolic murmurs. A large mass, evidently the spleen, was palpable in the abdomen. Its limits were one inch to the right of the midline; 10 inches below the xyphoid in the midline; 8 inches below the costal margin in the mammary line; 5 inches below the costal margin in the anterior axillary line. The mass was firm, somewhat movable, and not tender. The edge of liver was palpable two centimetres below costal margin. The hæmoglobin was 28 per cent.; red cells, 1,600,000. The Wassermann reaction was negative. The weight of the patient on admission was 102 pounds. The patient was transfused by another surgeon on February 15, 1914, about 600 c.c. having been given. Hæmolysis resulted and it was thought that the condition of the patient was too poor to warrant a splenectomy. At 8.30 P.M., on March 7, the patient began to vomit bright red, bloody fluid, six times in twelve hours, in all 42 ounces. At 11 P.M. the pulse was 120 and became weak and small. An intravenous infusion of 24 ounces of normal saline solution was given. She continued to vomit blood at frequent intervals for the next four days. At intervals during this time horse serum was administered subcutaneously without effect. Her movements at this time contained considerable blood. The pulse continued very weak and small. On March 26, she had a chill, lasting 20 minutes, and one-half hour afterward a temperature of 104° F., respiration 28, and pulse 124. On March 27, examination of the heart showed that at the apex there was a fairly loud systolic murmur not transmitted; at the base, there was also a systolic murmur, probably hæmic. The temperature ranged from 99 to 102° between the first and second transfusions. At this time the patient's hæmoglobin was 10 per cent.; red cells 900,000; and her condition extremely bad. Her weight was 89 pounds. She was transferred to Surgical Service. A donor for transfusion was obtained and extremely careful tests were made between his blood and that of the patient. On March 31 transfusion was performed by Dr. Pool by

Date	Red blood-cells	Hæmoglobin	Monoblasts	Megaloblasts	White blood-cells	Polymorphonuclears	Lymphocytes	Basophilic leucocytes	Eosinophiles	Polychromatophilia	Achromia	Pœcilocytosis	Amiocytosis	Remarks
February 4, 1914	1,600,000	p. ct. 28	0	0	1,900	p. ct. 75	p. ct. 21	0	p. ct. 4	Slight	++	++	++	After first transfusion.
February 25, 1914	2,260,000	29	0	0	3,800	73	27	0	0	Slight				Wassermann negative.
March 9, 1914	.....	20	....	....	.....	..	..	..	..	.....	.....	....	....	Blood for urobilin negative.
March 12, 1914	.....	15	....	....	.....	..	..	..	..	.....	.....	....	....	Several large gastric hemorrhages.
March 13, 1914	.....	13	....	....	.....	..	..	..	..	.....	.....	....	....	
March 18, 1914	956,000	12	0	0	13,800	88	11	0	1	Marked	+ +	+ +	+ +	Before transfusion.
March 31, 1914	.....	10	....	....	.....	..	..	..	..	.....	.....	....	....	After transfusion.
March 31, 1914	.....	22	....	....	.....	..	..	..	..	.....	.....	....	....	After splenectomy.
April 3, 1914	1,600,000	14	3,850	130	9,300	84	16	0	0	++	+	+ +	+ +	
April 5, 1914	1,200,000	15	7,400	310	7,700	75	24	1	0	++	+ +	+ +	+ +	
April 7, 1914	1,800,000	19	4,800	2,100	9,100	88	12	0	0	+	+ +	+ +	+ +	Urobilin in urine.
April 13, 1914	1,700,000	19	4,200	930	13,500	88	12	0	0	+	+ +	+ +	+ +	Urobilin in urine.
April 14, 1914	1,600,000	20	6,300	1,400	14,000	79	21	0	0	+	+ +	+ +	+ +	
April 17, 1914	1,700,000	22	2,000	200	10,200	71	29	0	0	+	+ +	+ +	+ +	
April 24, 1914	2,000,000	25	800	110	9,000	62	38	0	0	0	Slight	+ +	+ +	
May 1, 1914	2,100,000	26	1,100	60	5,900	36	61	0	3	0	Slight	+	+	
May 8, 1914	2,100,000	29	1,300	280	7,000	26	65	0	9	0	Slight	+	+	

the Lindeman method, about 700 c.c. being transfused. The patient improved considerably and about twenty minutes afterward Dr. Pool removed her spleen.

A vertical incision was made through the left rectus muscle; the upper pole of the spleen was adherent to the diaphragm, and in separating these adhesions a large vein was torn which caused successive hemorrhage. The spleen was rapidly delivered, its pedicle tied off, and the wound closed without drainage. This occupied twenty-two minutes. The patient made an uneventful recovery.

The blood count on several occasions and the pathological report of the specimen are herewith appended.

The pathologist reported that the removed spleen presented lesions essentially those of a chronic interstitial splenitis, typical of Banti's disease.

CURE OF SARCOMA OF THE DORSAL AND LUMBAR VERTEBRÆ UNDER THE TREATMENT WITH THE MIXED TOXINS

Dr. William B. Coley presented a man, twenty-one years of age, who after having wrenched his back in the fall of 1898, while wrestling, felt some pain the next 2 or 3 days, which disappeared. A short time later, he again began to feel pain and stiffness in the region of the injury. In December, 1900, he was examined by Dr. V. P. Gibney, who found a small kyphus in the lower dorsal region, and diagnosed the trouble as Pott's disease and had plaster casts applied. The patient's condition steadily grew worse, however, and general weakness developed. In April, 1901, he entered the Montefiore Home for Incurables; he continued to grow steadily worse. In February, 1902, Dr. Coley first saw the patient in consultation with Dr. V. P. Gibney, and quite agreed with him as to the hopelessness of the condition, and stated that nothing more than temporary relief could be expected from the toxins. Physical examination at this time showed a very large tumor of the back, markedly protuberant, occupying the entire region from the eighth dorsal vertebra to the third lumbar; it extended three inches on either side of the vertebral line, and protruded at least three inches beyond the normal surface. The muscles of the thigh and legs were greatly atrophied; there was extreme general emaciation. The patient had lost nearly 60 pounds in weight.

Treatment was begun on February 18, 1902, injecting ½ minim of the mixed toxin of erysipelas and of bacillus prodigiosus into the buttock; the subsequent treatments were given by the members of the house staff of the Montefiore Home, under the direction of Dr.

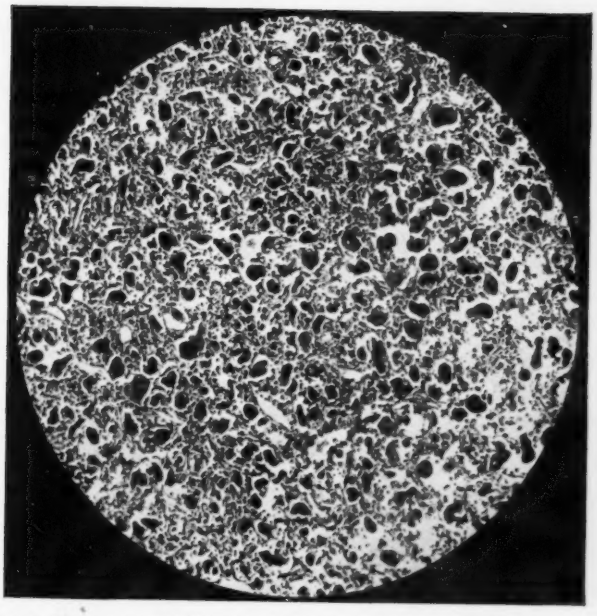

FIG. 1.—Inoperable round-celled (giant-celled) sarcoma of dorsal and lumbar spine (Coley).

FIG. 2.

FIG. 3.

FIGS. 2 and 3.—Radiographs of spine 12 years after disappearance under toxin treatment of very large inoperable sarcoma of dorsal and lumbar vertebræ.

Wachsman and Dr. Coley; the dose was increased by ½ minim each day. On February 24, the history states, Dr. Wachsman thought the tumor seemed somewhat smaller and there was no redness or irritation of the skin. The first chill occurred on February 27, following a dose of 3 minims; the temperature rose to 103.4°, accompanied by pain, nausea and vomiting stained with blood; the pulse was weak and rapid, respiration rapid; blood-stained diarrhœa. The condition was so bad, that the treatment was not resumed until March 6, when 3 minims again caused a temperature of 103.4° accompanied by nausea, vomiting, pain and chills. An interval of 4 days was allowed before the next treatment, a dose of 2½ minims was given; this was followed by a chill and temperature of 103.8° accompanied by chills, the same result followed the administration of 3 minims on March 18 and 20. It was then thought best to give him a short interval of rest. In the meantime, under Dr. Gibney's direction, everything possible was done to stimulate his appetite. On April 2, the treatment was resumed, 1½ minims producing a temperature of 99.2°; April 3, 2 minims caused a temperature of 100°. On April 7, a dose of 2 minims was followed by a temperature of 99.6°. His susceptibility apparently had increased over that in the first period of treatment, as 2½ minims, given on April 11, caused a temperature of 103.4°; on April 12, 2¾ minims produced 104.2°; on the thirteenth, 3 minims caused 103°; on the fourteenth, following the same dose (3 minims), he had a temperature of 108.8°, showing what I have not infrequently observed—the cumulative action of the toxins following a series of daily doses. In spite of this temperature 2¾ minims were given the following day, and followed by only 100°, temperature. 2½ minims given on April 16 caused a temperature of 100°, same dose on the seventeenth, 103.6° temperature, with severe chills and lumbar pain.

The treatment was continued with intervals of 1–3 days' rest, up to May 15. At no time did the patient develop the tolerance to the toxins, which is usually observed when the injections are given for a prolonged period in gradually increased doses. The last dose given on May 15 (2½ minims), was still able to produce a temperature of 104.6°, with severe chills.

Evidently by this time the tumor had become broken down and necrotic, because from then on until June 5—without any toxins—the patient had a daily rise of temperature, often as high as 104°, due undoubtedly to the absorption of broken-down tumor products. In the meantime, the tumor had shown a steady diminution in size, and by June 5 the improvement was so marked that it was thought inadvisable to give

further treatments. By the end of September, 1902, the total paralysis had become replaced by fair motor power and ability to walk; reflexes had again reached their normal condition, and the area of sensory disturbances had diminished in extent and intensity. There was still some retention of urine, and some constipation. Dr. Gibney applied a plaster jacket which the patient wore for a number of months; improvement went on until early in 1903 when he had entirely recovered and the plaster jacket was discontinued. He resumed his regular occupation and has been working ever since.

This patient was presented before the New York Surgical Society three or four years after his recovery, but he moved to a Western state and was lost sight of until August 10, 1912, when he reported by letter that he had been in excellent health the entire time, was married, and had two children. He has now returned to New York. He weighs 146 pounds; more than he has ever weighed, and is able to do any kind of work; the X-ray photograph taken May 16, 1914, is of great interest.

Report of X-ray Examination (May 16, 1914).—Examination shows between the twelfth dorsal and third lumbar vertebra, there is now a bony outgrowth extending at least 1 inch on both sides of the spine and posteriorly about 1 inch to a plane corresponding to the ends of the spinous processes. On the lateral view there is absence of the body of the first lumbar vertebra, *i.e.*, a kyphosis.

The condition is more that of a constructive lesion than a destructive lesion. The X-ray appearance is consistent with a new growth in which the process has ended in a deposit of bone in a soft destructive tumor, rather than that of a bony tumor from the beginning (Byron C. Darling).

A case very similar to this has recently been successfully treated with the toxins at the Massachusetts General Hospital, by Dr. Harmer, in the service of Dr. Charles A. Porter. The case will later be reported in full.

PROLAPSE OF RECTUM—MOSCHCOWITZ OPERATION

Dr. H. H. Lyle presented a woman, aged fifty-four years, who was admitted to St. Luke's Hospital with the diagnosis of prolapse of the rectum. In 1906, at Buenos Ayres, she had undergone a right salpingo-oöphorectomy; later, a complete hysterectomy at a sister institution in this city. On the second day she was gotten out of bed, and "her remarkable cure" was ascribed to the fact of her early rising. On admission to St. Luke's the patient's general and local condition was deplorable. The rectum projected for a distance of 4 to 5 inches, the surrounding skin was excoriated and the site of a

"weeping eczema." The patient was put to bed and soothing local applications were applied to relieve the distress. After ten days the abdomen was opened and the prolapse corrected by the Moschcowitz method. Some difficulty was experienced in closing the anterior portion of the cul-de-sac of Douglas. The removal of all the pelvic organs had left a large space and the numerous adhesions from the former laparotomies had rendered the peritoneum less movable. To overcome this the stumps of the round ligaments were freed and attached to the anterior aspect of the rectum and to one another. The patient made an uneventful recovery, and since leaving the hospital has performed hard physical work. The interesting point is the success of Moschcowitz's method under very unfavorable conditions, a wide pelvis with no uterus or vaginal support to aid, and a peritoneum that had lost much of its pliability through former operations and inflammations. In this case the stumps of the round ligaments were found and used to supply a peritoneal covering to aid in closing the anterior aspect of the cul-de-sac of Douglas.

TROPHIC AND CIRCULATORY DISTURBANCES OF THE EXTREMITIES

DR. WILLY MEYER presented a number of patients illustrating trophoneurotic and circulatory disturbances of the extremities.

CASE I.—This was a man of fifty-seven years, with a Charcot's hip; this in the hip-joint was rather a rare disease. He showed all the typical signs of cord affection consecutive to specific infection; the joint had entered a rather acute stage after his having carried a heavy weight. When he entered the hospital, the region of the hip was very much swollen; pronounced crepitation was present. The X-ray showed the head worn off to a great extent and the capsule covered with irregular vegetations. There was no pain whatever, no limitation of motion, as was usually found in cases of this kind. The patient had been warned against heavy lifting in order to avoid fracture and had also been advised to wear a mechanical support should the trouble increase.

Dr. Meyer next presented a number of younger patients treated with subcutaneous injections of saline or Ringer's solution 4–500, as recommended a year ago by Dr. Koga of Ito's clinic in Kayoto, Japan, and published in the *Deutsche Zeitschrift für Chirurgie.*

The first was a young man of thirty, with neuropathic gangrene of two toes, due to syringomyelia of the dorsocervical region; there was no syphilis nor diabetes and a splendid pulse in both anterior and posterior tibial arteries. Nevertheless, he had developed gangrene. Examina-

tion by Dr. Geo. W. Jacoby, the neurologist of the German Hospital, had established the diagnosis. Inasmuch as one older brother, evidently with the same disease, had died in another hospital, after both extremities had been amputated in various places, hypodermoclysis of Ringer's solution was, as an experiment, tried before resorting to amputation and, strange to say, brought complete relief. The patient was able to work again; sometimes there was a marked cyanosis of the anterior part of the foot. Dr. Meyer did not venture to explain the observation, but stated that he wanted to put the case on record. It almost seemed that in addition to the neuropathic affection, there had existed a condition of the blood which was markedly improved by the treatment.

Three further cases were shown, all being young people with endarteritis. One, who had gangrene of the big toe and first metatarsal bone, was cured by arteriovenous anastomosis of the femoral vessels done in Scarpa's triangle, according to Whiting. The operation was performed in May, 1913; the wound healed by primary union. The pains at first continued, but were much improved after the removal of the toes and metatarsal bone, which was done nine days after the first operation. It was interesting to see that at that time there was distinct arterial hemorrhage, of course, with spurting, requiring three ligatures. The wound healed very slowly; the scar broke down at times in small areas. The patient was without pain and able to work, in robust health. If ever the pain should return or the scar should prove to remain obstinate, Dr. Meyer intended to try Ringer's solution. He certainly would have done this before doing the anastomosis, but the article by Koga had not been published at the time of the operation.

One of the two patients shown was a young man who had come to Dr. Meyer's office with this affection, with all four extremities involved. At the left wrist the radial artery and at the right the ulnar were pulsating, but rather feebly. Nine years ago he had an obstinate ulcer of the tendo Achilles which required his staying in the hospital for many weeks. Thiersch's grafting finally cured the trouble. But the pain persisted more or less. He came to the hospital markedly anæmic with pain in all four extremities and a localized gangrene on the radial side of the middle finger. He received 24 hypodermic instillations and was now back at work and without pain. The same good result was shown in another man who had trouble in one extremity.

Arbitrarily Dr. Meyer had decided to make the injections about 24 times, daily or every other day, sometimes only twice a week, according to the patient's sensitiveness, below the clavicle, under the breast and on the outer side of the thighs.

Of course, this treatment will not be successful, probably, in every case; but, as it seemed, it was so in quite a number. One remarkable effect was seen in a patient of forty, at the German Hospital, in whom amputation of one thigh was done years ago, for the same trouble. Now he had come to the hospital with the opposite side affected. He refused to have the thigh amputated, but consented to a Pirogoff, which was done at the end of January. However, gangrene set in again, and it was decided to try the Ito-Koga treatment. The result was that the gangrene was arrested, the man was markedly improved in general health, the pain ceased and he could have a secondary amputation done just above the ankle a few days ago. This would give him the great advantage of a longer stump below the knee.

Dr. Meyer thought that amputation should no longer be advised in these cases as the only possibility. In his opinion it should be the last resort. First he would try the instillation of Ringer's solution; then, if this was not successful, he would do arteriovenous anastomosis and, only if this failed, amputation.

CIRCULATORY AND TROPHIC DISTURBANCES OF THE EXTREMITIES: AN ATTEMPT AT CLASSIFICATION

Dr. Howard D. Collins read a paper, with the above title for which see page 742.

THROMBUS AFTER END-TO-END ANASTOMOSIS OF THE POPLITEAL VESSELS

Dr. Robert T. Morris presented a specimen showing a thrombus at the site of an arteriovenous anastomosis. The patient was a man, forty-seven years old, who entered the hospital with thrombo-angeitis of the left foot, and gangrene had already involved the little toe. The toe was removed and treatment instituted by giving hypodermoclysis of Ringer's solution. These had the effect of stopping the excruciating pain, and halting the gangrenous process. The wound, however, refused to heal. Dr. Morris then made an end-to-end anastomosis between the popliteal artery and vein. For two days the foot was warm and with normal sensation. On the third day gangrene appeared and on the fourth day the leg was amputated. There had been no sepsis at the seat of operation. The specimens of popliteal vessels removed showed a small thrombus adherent at the suture line. Examination of the amputated leg showed numerous old and new thrombi. Examination of the patient's blood at the time of his entrance to the hospital was negative so far as finding any organisms was concerned.

DUODENAL HEMORRHAGE

DR. FREDERIC KAMMERER showed the specimen of a case of fatal duodenal hemorrhage, for which a gastro-enterostomy had been done and a pyloric exclusion attempted by tying off the stomach with a stout silk ligature, the condition of the patient precluding a von Eiselsberg's exclusion. The history and X-ray findings in this case had rather suggested the presence of some neoplasm in the small intestine than a duodenal ulcer. During the night before operation the patient had a severe intestinal hemorrhage, but his condition the next morning was not serious. At operation an unusually well developed Lane's kink was found, nothing in the small intestine, but a typical duodenal ulcer, situated on the posterior wall, about one inch from the pylorus. An excision was deemed inadvisable on account of the many adhesions. The above-mentioned operations were done, during the course of which it became evident that hemorrhage from the ulcer had ceased temporarily, as the small intestine immediately below the ulcer contained no blood; but further down a blackish-blue discoloration, which extended into the large intestine, clearly indicated the presence of a large amount in that part of the intestinal tract. The patient rallied well from the operation, but 36 hours later he became restless, his pulse ran up to 130–140, his face became blanched. Six hours later, a donor having been found, an attempt was made to do a transfusion, but the patient expired on the operating table. At the autopsy a not very deep ulcer, almost a square inch in size, was found on the posterior wall of the duodenum. The base of this ulcer showed only moderate induration. Exactly at the centre of the same a small opening was easily recognized, from which a drop of blood exuded. This proved to be an erosion in the wall of a branch of the superior pancreatic-duodenal artery, as a probe, introduced at this point, readily passed into the larger vessel. The speaker said this was the second case of fatal hemorrhage from a duodenal ulcer that he had observed during the past year. In the first case the hemorrhage was so severe that an operative procedure was out of question. A study of the specimen presented this evening had left some doubt in the mind of the speaker as to the wisdom of the course he had pursued—at least in this instance. At the autopsy the upper portion of the intestinal tract was also filled with blood, showing that renewed hemorrhage had occurred after gastro-enterostomy and exclusion. The anatomical conditions at the site of the ulcer could, in all probability, have been successfully met by incision of the duodenum and some kind of ligature of the small bleeding point.

TRANSACTIONS
OF THE
PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting held May 4, 1914
DR. G. G. ROSS in the Chair

UNUNITED FRACTURE OF THE NECK OF THE FEMUR, TREATED BY BONE-TRANSPLANT

DR. ASTLEY P. C. ASHHURST presented a man, thirty years old, who in August, 1913 (seven months after injury), came under his care at the Orthopædic Hospital, in Dr. Harte's service, and was found to have an ununited fracture of the neck of the right femur. He was unable to walk without crutches, on account of pain and weakness; he could stand alone, and even bear momentarily all his weight on the injured limb, but the hip grated, and the trochanter slid up and down on the pelvis. There was shortening of an inch and three-quarters. A skiagraph showed an ununited fracture at the base of the neck, oblique, and the longer fragment belonging to the head of the bone and the front of the neck (Fig. 1).

The patient was referred to the Episcopal Hospital (there being no vacant bed at the Orthopædic Hospital), and admitted to Dr. Frazier's service. Operation was done by Dr. Ashhurst on August 22, 1913.

1. An incision was made downward for 3½ inches from the anterior superior spine of the ilium, passing between the sartorius and tensor fasciæ femoris, and then between the ilio-psoas and rectus muscles. The capsule of the hip joint was then opened and detached widely from the anterior intertrochanteric line, exposing the line of fracture, which was bevelled at the expense of the posterior surface of the neck, and extended anteriorly to the extracapsular region of the great trochanter. Only fibrous union was present, and the fragments were easily pried apart with a bone elevator. The fractured surfaces were then freshened. It was now found that by outward rotation, followed by longitudinal traction and finally by inward rotation, the fragments were jammed together in good position. The wound was then temporarily packed with gauze.

2. A bone peg (Fig. 2) was removed from the crest of the left tibia by means of the speaker's circular saw (Fig. 3); the dimensions of this peg were four and a half inches long, and one-half by three-eighths by three-eighths of an inch thick (11.5 cm. long, and 1.5 cm. by 1 cm. by 1 cm. thick); it tapered slightly at its lower end. This bone peg was temporarily put in hot salt solution, and the leg wound closed.

3. The fracture of the cervix femoris was set under control of direct vision, by outward rotation, longitudinal traction, and finally inward rotation. While the limb was securely held in this position, an incision one and a half inches long was made over the great trochanter, and by means of a steel drill in a hand-driven brace (Fig. 3) a hole was bored through the trochanter and neck into the head. First a drill three-eighths of an inch in diameter was used, then one fifteen-thirty-seconds of an inch in diameter; and as the peg proved too large to be driven in through this hole, a drill half an inch in diameter was finally used. The peg fitted this hole very snugly, and it was necessary to drive it home with very vigorous blows from the mallet (Fig. 4). Some of the projecting end of the peg was then cut off. The two wounds in the hip were then closed, and the limb dressed in plaster of Paris from toes to axilla, in an abducted position. The time of the entire operation, including plaster of Paris, was two hours.

September 22, 1913: One month after operation, the plaster case was removed below the knee.

October 12, 1913: Seven weeks after operation the remainder of the plaster case was removed. There was no stiffness or thickening around the hip joint, and the incisions were healed. The end of the bone peg was palpable beneath the skin over the great trochanter. There was no shortening of the limb and no movement between the fractured surfaces. Rotation at the hip was normal. Flexion to 150 degrees was easy and painless. The patient was to stay in bed two weeks longer.

October 20, 1913: Allowed to be up in wheel-chair.

October 25, 1913: Walking with crutches and a high shoe on the left foot, preventing any weight-bearing on the fractured limb.

November 27, 1913: Discharged from the ward, with directions to bear no weight on the right foot until six months after operation. A skiagraph made about this date showed the same conditions as Fig. 4. Figs. 5 and 6 are from photographs made December 1, 1913, four months and a half after operation.

Soon after this time the patient returned to his home in Ohio. About the first of the year (over four months after operation) he was

FIG. 1.—Ununited fracture of cervix femoris, seven months after injury. Unable to walk without crutches.

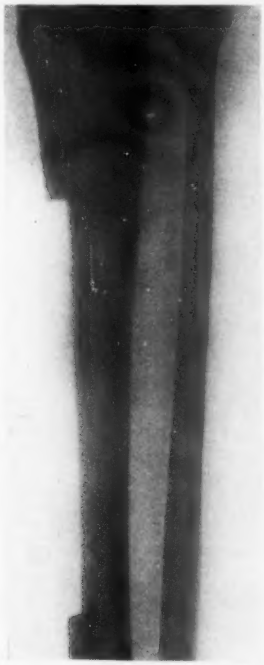

FIG. 2.—Showing defect in tibia after removal of bone peg.

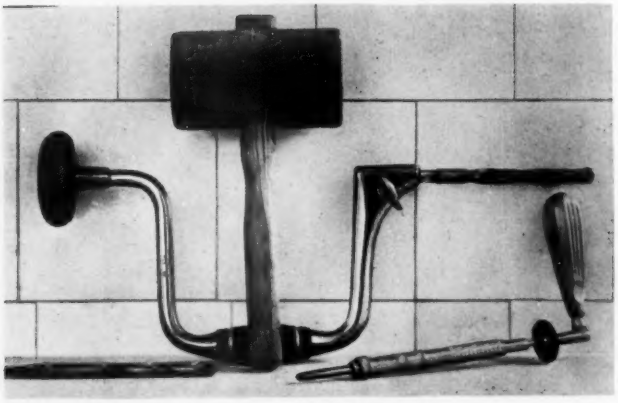

FIG. 3.—Circular saw, brace, drills and mallet used in transplanting a bone peg for ununited fracture of neck of femur.

FIG. 4.—Bone peg in ununited fracture of cervix femoris (skiagraph made through plaster-of-Paris dressing 10 days after operation).

FIG. 5.

FIG. 6.

FIGS. 5 and 6.—Bone peg implanted in neck of femur for ununited fracture. No shortening, free motions, four months and a half after operation.

FIG. 7.—Skiagraph eight months after insertion of bone transplant, showing incomplete fracture of the transplant and secondary coxa vara.

permitted to abandon the use of the high shoe, but was directed to continue the use of crutches. This, however, he did not do. He felt so well and strong, he wrote, that as soon as he gave up using the high shoe he threw away his crutches. The effect of this was apparent when he next presented himself for observation on April 20, 1914. He was now wearing a lift in his right heel, as he felt the limb was shorter than the left. Measurements showed a shortening of half an inch; in December, 1913, there had been no shortening. Otherwise the hip was in good shape: there was flexion to about 70 degrees, free rotation, abduction through about 10 degrees, and all these motions were painless. Walking was easy without any support, but there was a noticeable limp; the man had not been able to return to his usual occupation in the pottery, as this involved heavy lifting, and his employers were unwilling to risk an accident though the man himself said he was sure he could do the work. Meanwhile he had been doing odd jobs, but he had no steady employment. His chief complaint was of pain above the knee, worse after resting. When his knee gets limbered up he walks with very little limp.

A skiagraph was taken (Fig. 7), and this promptly revealed the cause of the shortening; the transplant had fractured, and the resulting coxa vara prevented as free abduction as had been present before the patient resumed weight-bearing on the limb. In spite of the fracture of the transplant, the fragments seemed to be firmly united, though little callus is visible in the skiagraph. It is interesting to see that the end of the bone peg projecting beyond the trochanter is gradually being absorbed. In Albee's similar case, of which an illustration is given in Murphy's Clinics (June, 1913, Fig. 98), it is stated that the skiagraph (five weeks after operation) shows proliferation of bone from the protruding end of the bone peg. In the skiagraph of the present patient there is apparent quite a growth of bone on the surface of the femur around the drill hole, but this, I believe, is due to extension from the femoral shaft and not due to growth in the transplant. Dr. Albee always preserves the periosteum in his transplants, and Dr. Murphy does likewise, but in Dr. Ashhurst's operations he has always removed the transplant subperiosteally, regarding the periosteum simply as a limiting membrane. McWilliams, however (*Jour. Amer. Med. Assoc.*, 1914, i, 346), has reported very careful experiments, in which he comes to the conclusion that it is very important to preserve the periosteum because it renders the transplant more easily permeable by surrounding capillaries, thus ensuring the early establishment of an adequate circulation through it. His experiments certainly show the

value of preserving the periosteum, since in a number of instances he secured reproduction of bone from periosteum alone; but there may be another reason than that given by Dr. McWilliams for the greater liability of the bone graft to be absorbed when it is uncovered by periosteum. This may very well be that the periosteum really acts only as a limiting membrane, and *protects the transplant from solution by the cells of the surrounding tissues.* When the transplant is *embedded within osseous tissue,* as is the case in the transplant figured in the accompanying illustrations, and in the transplants used for splinting the tuberculous spine, there is apparently little fear of its absorption; when, on the other hand, it is embedded, not in osseous tissue but in the soft tissues, it is very likely to be absorbed unless protected from solution by an envelope of periosteum, its *normal limiting membrane.* Thus it is not surprising to see in Fig. 7 that the end of the bone peg projecting beyond the femur is being absorbed, while that embedded within bone, or in immediate contact with living bone, preserves its form unaltered. It will be interesting to know what became of the end of Albee's transplant eight months or more after operation. J. B. Murphy has reported one case (Murphy's Clinics, October, 1913, vol. ii, p. 797) in which he thought the preservation of the periosteum was detrimental to the production of new bone, but unfortunately the stenographic report of his remarks is so inaccurate that it is imposible to know just what was done: the skiagraphs he presents indicate that a subperiosteal resection of the upper end of the humerus was done for cystic osteitis, and that in the place of the diseased humerus (removed subperiosteally) a transplant was inserted which had its own periosteum still in place. The subsequent skiagraphs (Figs. 200–204) indicate that the transplant with its periosteum was then surrounded by new bone formed between the transplant and the ensheathing periosteum which belonged to the excised humerus, and Dr. Murphy states that the periosteum which belonged to the transplant acted detrimentally in that even as long as seven months after operation it remained as a white line (visible in the skiagraph) between the transplant and the surrounding new-formed bone. But though all the skiagraphs clearly indicate that this new-formed surrounding bone developed beneath the original periosteum of the (subperiosteally) excised humerus, it is stated in the text of Murphy's Clinics (p. 788) that the periosteum was excised along with the diseased humerus.

Although the patient presented has been walking on his leg without any support from crutch or cane for a period of four months, it is scarcely possible to reckon his present condition as an end-result.

He has not returned yet to his ordinary work, but there seems every likelihood of his being able to do so within a short time.

Finally, Dr. Ashhurst suggested that bone transplantation is a better method of treating ununited fractures of the hip than the use of nails, screws, etc. But, as the present case demonstrated, it is not safe for the patient to bear weight on the limb as soon as four and a half months after operation. This patient did so contrary to advice, and as a consequence he fractured the transplant.

In an interesting paper on the subject of intracapsular fractures of the hip, read before this Academy two years ago by Dr. G. G. Davis (*Trans. Phila. Acad. of Surg.*, 1913, xv, 112), the following were among the conclusions reached:

"The surest way of remedying cases of ununited fracture of the neck of the femur is to cut down, freshen the edges of the fragments, pin them together with screws, nails, or other means, and put them up in the abducted position. When foreign bodies are inserted to pin the fragments together they are likely to cause discomfort sufficient to necessitate their removal. Considerable discomfort follows the operation and the patient is inclined to attribute this to the nail or screw and demand its removal. Firm union can be obtained by freshening the surfaces of the fragments and then jamming them together by widely abducting the limb and fixing it in plaster of Paris without the use of any nails, screws, or other fixation appliances."

These conclusions of Dr. Davis, who has had more experience than any other Fellow of the Academy with operations for ununited fractures of the hip, were reached before the operation of bone transplantation came into general use; and it seems that this is a better method of fixation than the use of foreign material such as nails, screws, or even ivory pegs; and that some form of direct fixation of the fragments is extremely desirable, though it had been shown by Dr. Davis that in some cases it was possible to secure firm bony union without direct fixation.

Dr. J. T. Rugh said that last fall he made bone-grafting for ununited fracture of the neck of the femur in the case of a woman forty-three years of age, who had suffered a fracture two years before. Two years ago, he put in a silver wire nail, which remained in place until the second operation. At the time that he put in the nail, after freshening the edges, he was surprised at the softness of the bone in the upper end of the femur. The nail was driven in with the greatest possible ease, so that the bone was evidently partially degenerated, and at the end of two years while the nail was in place, there was no attempt at union. She could walk slightly on the part, but a slight upward dislocation had

taken place. Last October he again operated, took out the nail and enlarged the hole the nail had made, but even the bone structure in her tibia was so soft that when he attempted to drive the graft into the hole in the neck of the femur, the graft itself broke down like very soft wood, so that her bone structures all over her body were decidedly poor. This taught him that not all cases of ununited fracture are amenable to treatment by this method, because of the condition of the bone in the individual.

DR. GWILYM G. DAVIS said that if the patient has good enough bone to make a transplant the question of using the transplant as a peg promises to solve the question as to what means shall be used to fix the fragments. He remembered the trouble experienced in using pegs or pins of steel and screws—for instance, one of his cases simply complained of pain although the wound was long healed, tightly and apparently satisfactorily. The patient knew the steel was in there and he could not get the idea out of his head that it should come out. At last he found a doctor who tried to take it out but he could not find it, and simply left a nasty sinus through which later Dr. Davis had to take out the screw—no matter what foreign body is put in, the surgeon is liable to hear from the patient sooner or later. This case just cited occurred before the suggestion was made by Albee of using a bone pin.

DR. DUNCAN L. DESPARD inquired whether Dr. Ashhurst felt that a bone peg is a distinct advance over the silver nail in fracture of the neck of the femur? In the last three years he had attempted this operation in 3 cases, all patients older than his, the youngest being fifty-four years of age. In each of these cases at the time of operation there had been a tremendous amount of absorption of the head of the bone, and he practically had no hope of bony union and only tried for an ankylosis. He did not think any results in his cases had been very much of an improvement. They walk with decided limps. It is a question whether the bone peg offers very much more than the silver nail. It does not stand as much strain as the nail, and the difficulty of keeping the patient quiet for the long period of time required is not to be overlooked.

DR. ASHHURST, in response to Dr. Despard's query, called attention to the remark of Dr. Davis that bone pegs should be an advantage over foreign bodies because the patient is not satisfied to allow foreign substances to remain. If the patient has only his own bone it is reasonable to suppose his mind will be relieved. This bone is either an absorbable foreign body or else remains as bone. It will promote osteogenesis and so procure firm union.

CINEMATOPLASTIC AMPUTATIONS

Dr. A. P. C. Ashhurst presented a brief paper, with this title, for which see page 750.

Dr. Gwilym G. Davis remarked that it seemed to him that there was a field for this type of amputation and he thought that surgeons would be more careful in the way that they do amputations and operate more from the utilitarian standpoint. For instance, in the lower extremity the adaptation of an artificial limb is often interfered with by the lateral protrusion of the bones in the knee-joint and ankle-joint. If such a person wishes an artificial appliance around the foot, anything placed over this protrusion increases the width of the ankle so much that it gives the impression of a marked deformity, which is of course very objectionable. That can be obviated by making the section above the ankle and getting rid of the swell of the ankle, so that when one adds the apparatus in addition to the natural stump it makes a diameter equal to the normal ankle. The operation suggested by Dr. Ashhurst is along the same lines. It is interesting that in these particular cases the biceps was united to the triceps. The biceps flexes and the triceps extends. Look at the field this opens. All we have to do is to divide the arm laterally and lift the triceps posteriorly and the biceps anteriorly, make a sling on each of them, and then when the attempts to contract are made the patient can contract either one and you have a double action of the muscles. This suggests the question as to how the patient must think to produce a contraction of the loop. One might expect the muscles to act irregularly, and to make them work regularly will require special training of the cerebrum.

When we come to the question of transplanting muscles of the knee, where you take the hamstring muscles, which are flexor muscles, and bring one of these forward to the patella and make it an extensor muscle, then when the patient contracts the muscles it simply stiffens the limb without giving any special direction, and that works very well. But he was not convinced that it has been definitely demonstrated that we can, within a reasonable time, take a flexor muscle and deliberately sandwich it in among the extensor muscles and expect it to act contrary to its original method.

RETENTION CYSTS OF THE PANCREAS

Dr. John Speese read a paper with the above title, for which see page 673.

SUBLUXATION OF ULNA

Dr. John H. Jopson showed a case of subluxation of the lower end of the ulna in a girl aged fifteen with the following history: Eighteen

months before he first saw her she had fallen and fractured her right wrist and was told, after an X-ray examination, that the wrist was broken in two places. She wore splints for six weeks. She has had more or less trouble with the wrist since that time, and more especially since she went to work in a cigar factory two months ago. Since that time there has been noted considerable pain and deformity. Examination of the wrist showed a deviation of the hand towards the radial side. There was no silver fork deformity. In pronation the normal prominence of the head of the ulna was present and even somewhat exaggerated on the back of the wrist (Fig. 8). On supination a well-marked subluxation of the lower end of the ulna forward was noted, and the articular surface could be readily palpated on the front of the wrist (Fig. 9). In this position of the hand there was a marked groove between the dorsal surfaces of the bones, and the sigmoid cavity of the radius could be palpated on the back of the wrist. Reduction and re-dislocation occurred with each motion of pronation and supination respectively, and these movements were painful. The X-ray showed an old Colles fracture of the wrist in good position, about half an inch above the end of the bone. There was an unhealed fracture of the styloid process of the ulna. The fracture of the radius had apparently resulted in shortening due to impaction. The ulna seemed longer than its neighboring bone, although this did not show prominently in the X-ray.

The operative problem seemed to be to shorten the ulna, to fix the bones in their normal relation by re-attaching the styloid process and with it the triangular cartilage in their normal positions, and to secure additional fixation by suture of the ends of the radius and ulna to each other. The following operation was performed: An incision about three inches long was made on the dorsal surface of the ulna, parallel with, and near its radial border. The posterior ligament of the wrist was severed and retracted, exposing the head of the ulna; the periosteum was elevated, and the end of the bone with its articular surface resected for about 1 cm. The edges of the sawed surface were rounded and a small hole drilled through the outer border. The periosteal covering of the adjacent borders of the radius and ulna was exposed and several sutures were passed, fastening the two bones together where they were in contact. Another suture was passed through the triangular cartilage and around the fractured styloid process, and through the hole which had been drilled in the head of the ulna. When this was tied the styloid process was brought in contact with the resected end of the bone. The posterior ligament was reunited and the wound closed.

FIG. 8.—Subluxation of the ulna.

FIG. 9.—Subluxation of the ulna.

Both silk and chromic catgut sutures were used. The arm was dressed in pronation on a palmar splint. The wound healed by primary union, but a small aseptic abscess developed as the result of irritation from one of the silk sutures, and a sinus remained for several months until the silk suture had separated and could be removed, when it promptly closed.

The result has been most gratifying. The patient shows perfect restoration of the movements of the wrist, supination and pronation being practically complete, with no tendency to a return of the luxation, and she is again working at her trade of cigar maker. She says that the wrist hurts her sometimes, especially in damp weather. The hand and forearm seem nearly as strong as normal.

Dr. Jopson further remarked that in the Transactions of the New York Surgical Society (ANNALS OF SURGERY, June, 1913) is the report of a case presented by Dr. William Darrach under the title of "Habitual Forward Dislocation of the Head of the Ulna," in which the symptoms were almost precisely the same as those which this patient exhibited. In Darrach's case the condition followed a series of injuries to a chauffeur, the radius being twice fractured by the back kick of an automobile, and fracture of the styloid process of the ulna being associated with it. The third injury, in which the wrist had been injured but not fractured, had resulted in this type of subluxation. The head of the ulna slipped out on supination and returned to its normal position on pronation. There was increased antero-posterior mobility at all times, and an X-ray showed the ulnar styloid to be still ununited, and a backward curve of the radius was present due to imperfect reduction of the fracture.

As Darrach remarked, luxations of the lower end of the ulna which are not associated with fracture of the radius are rare, there being 33 reported cases. With fracture of the radius the condition is much more common. He points out that even when the accident of dislocation has been recognized and reduction completed, a weakness at this joint may remain due to imperfect repair of the structures on which the strength of the joint depends, namely, the triangular ligament and the joint capsule. This is especially prone to be the case if the ulnar styloid is broken, as the attachment of the triangular cartilage to its base favors tearing loose of this important structure, which holds the ends of the radius and ulna together. Darrach could find only six cases of habitual dislocation of this joint: 3 reported by Hoffa and 3 by Courtin. He did not find the impairment of function in this case sufficient to call for operation at the time, but stated that if sufficient disability should re-

sult he would resect the lower inch of the ulna. In order to repair the damage completely he stated it would be necessary to obtain union between the ulnar head and styloid, and to reef the capsule, and also to overcome the backward bending of the radius with the resulting strain on the anterior portion of the joint capsule.

It is a well-recognized fact that dislocations, partial and complete, of the lower end of the ulna are frequent complications of Colles fracture, especially when associated with fracture of the styloid process of the ulna, and numerous clinical and experimental observations by Pilcher, Moore and others have made clear the anatomical reasons for this association. A persistent recurring subluxation of the type described by Courtin, Hoffa and Darrach, and a typical example of which is that here reported, is due to imperfect repair of the injured parts, especially of the fractured styloid, or to persistent strain on the joint due to imperfect reduction of the fractured radius, or to permanent shortening of that bone as a result of crushing and impaction. It may also accompany fracture of the forearm in its upper portion as in a case of Hamilton's referred to by Courtin, or fracture of the middle third of the radius, as in one of Hoffa's cases, or even certain forms of violence unaccompanied by fracture, or at least in which no fracture has been demonstrated, as from the lifting of a heavy weight, or where a child is violently lifted by pulling on its hand. The last-mentioned cause is emphasized by Tillmanns as one of the commonest etiological factors in subluxations, and while repair in these cases is usually complete and permanent, recurring subluxation may follow, as in one of Courtin's cases. Tillmanns also emphasizes the difficulty of retaining in place the end of the ulna in those complete dislocations in which fracture of the radius is an associated injury. That recurring subluxations and luxations of the radio-ulnar joint are not more frequently noted is probably because they are not looked for, and also because they do not necessarily impair the strength and usefulness of the joint. We have seen another typical example of subluxation of the ulna only recently in an elderly woman, who had sustained three fractures of the left forearm at various periods of her life, one of the fractures being a typical Colles for which we had treated her; and, aside from the deformity, the patient presented no symptoms. There was an associated fracture of the styloid of the ulna. On the other hand, some of the weak and painful wrists observed after Colles fracture are probably due to this condition, and it is an interesting fact that so many of the systematic works on fractures omit any mention of it, as Darrach has pointed out.

In one case a good result was obtained by following out to a certain extent the indications for operative correction which Darrach enumerated as indicated for restoration of normal relations in the wrist joint in cases such as his, with the exception of straightening of the radius, which was not necessary in our case, as the shortening of that bone was due to impaction and not overriding of a displaced fragment. A limited resection of the lower end of the ulna to shorten that bone was done without fear of compromising the motions of pronation and supination, as experience in cases of compound dislocation and other types of injury and deformity has shown such fears to be groundless. Hoffa operated upon two of his three cases; one a recurring backward dislocation without fracture, and the other a recurring forward dislocation following a fracture of the radius in its middle third. The procedure which he recommended is the opening of the joint capsule by a dorsal incision and the uniting of the periosteum covering the adjacent ends of the radius and ulna by two or three sutures, a simple operation which he found satisfactory in his cases and which he considers superior to the use of retention apparatus as advised by Mayer and others. While Hoffa's operation would be suited to some types of recurring luxation, it would not accomplish its purpose in those the result of Colles fracture with marked radial shortening, and in such we would practise the operation we have described, which combines the essential features of Hoffa's operation and that suggested by Darrach.

Three points might be emphasized: First, the advisability of more prolonged fixation of those fractures of the radius accompanied by separation of the styloid process of the ulna, which the X-rays have shown to be so common, in order that healing of the triangular ligament and those fasciculi inserting into its side and base may be obtained. Secondly, the more careful investigation of cases of weak and painful wrists following fractures to determine the causes of the impairment of function. Lastly, the consideration of an attempt to relieve by operative measures those cases in which such pain and impairment of function can be traced to imperfect repair of the structures mentioned.

TUMOR OF CAROTID BODY

Drs. John H. Jopson and John A. Kolmer reported the history of a case of tumor of the carotid body as follows:

A woman, twenty-seven years of age, was admitted March 18, 1913, to the Polyclinic Hospital, discharged March 30, 1913. Married three years ago; one child eighteen months old; now in the fifth month of her

second pregnancy. In July, 1911, one month before her child was born, she first noticed a small swelling below the angle of the jaw on the right side of the neck. This gave her practically no pain and has increased slowly in size. At the present time the patient presents herself with a hard, painless, movable ovoid swelling about the size of a pigeon's egg in the right upper cervical region, which resembles a tuberculous lymph gland. There is a small white scar below it near the anterior border of the sterno-cleido-mastoid muscle which has been present since childhood, and probably represents the scar of an old abscess. The diagnosis was tuberculous lymph adenitis.

Operation, March 19, 1913: Oblique incision in crease of neck over tumor. Removal by dissection of the solid tumor was accomplished without great difficulty, except at its anterior inferior border, where it was densely adherent, and could not be separated from the external carotid artery until that vessel had been doubly ligated and divided. The gland lay in the bifurcation of the common carotid artery adherent to, and apparently compressing, the external carotid which was smaller than usual, probably as the result of pressure, and was not identified as the external carotid until it had been ligated. The wound was closed and primary healing occurred, the patient being discharged cured at the expiration of eleven days. The tumor was sent to the laboratory of the Polyclinic Hospital for examination, and the following report was returned:

> Specimen was received in the laboratory in 4 per cent. formalin. The mass is roughly ovoid in shape; well encapsulated; quite firm and somewhat elastic; roughly nodular and greyish-white in color. The cut surface is smooth, white, homogeneous and even in texture.
>
> *Microscopical Examination.*—Sections present a well-defined capsule with irregular bands of connective tissue extending into the depth of the tumor (see Fig. 10). These bands divide and subdivide, forming an alveolar structure. The connective-tissue cells of these septa are, as a rule, long spindle-shaped cells, well defined and with mature oval nuclei. Scattered about are groups of younger connective-tissue cells with oval and slightly vesicular nuclei. Portions of the tumor show well-defined alveolar arrangement, but in most areas the structure is more diffuse. In the alveolar portions the cells are irregularly grouped, well defined, polyhedric or round, with round or oval, sharply defined nuclei. The protoplasm of these cells is quite homogeneous with poorly defined partitions between individual cells. The size of these cells varies, and evidences of mitoses are present. In a few places the alveoli appeared to be grouped about or are intimately related to blood spaces with several layers of polyhedral cells grouped about the layer of intimal cells. The vascular supply of the tumor is not especially abundant. The blood-vessels are not well defined, and the walls are thin

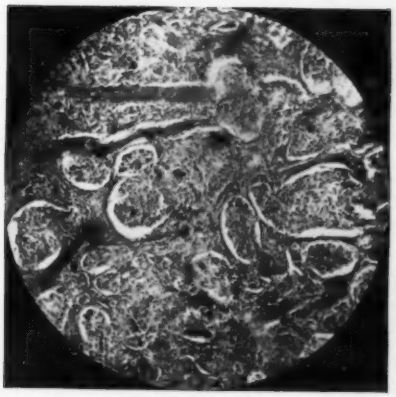

FIG. 10.—Tumor of the carotid body.

and often present only the endothelial lining. In many areas the typical chromaffin cells of the carotid gland are to be seen, and, since the normal structure of the gland is so disturbed by the new tumor tissue, these have aided in establishing the relation of the tumor to this gland.

Diagnosis.—Endothelioma or perithelioma of the carotid gland.

It will be seen that this case resembled, in its clinical course and operative finding, a number of the reported cases of tumor of the intercarotid gland, or carotid body. The number of cases on record is rapidly increasing as the attention of surgeons and pathologists is directed to the subject. Keen and Funke in 1906 published the first careful study of the subject in America, collecting 29 cases. The recent articles by Callison and Mackenty (ANNALS OF SURGERY, December, 1913) and Balfour and Wildner (*Surgery, Gynæcology and Obstetrics,* February, 1914) are quite exhaustive studies of the subject from the clinical and pathological standpoints. Callison and Mackenty brought the statistics up to date by collecting 31 cases in addition to Keen and Funke's series of 29, making 60 in all, and to these may be added the case reported in Balfour and Wildner's study of the anatomical and histo-pathological side of the subject, and our own case. Other cases are probably also already on record.

To reiterate the salient points of this case it will be noted that, as in the large majority of cases of this affection, the diagnosis of carotid tumor was not made before operation, nor, indeed, until the pathological report had been returned. This has been the common history in these cases. The tumor was, of course, solitary, of slow growth, of moderate size, and gave rise to no symptoms except a slight disfigurement. This is also the usual clinical history until the tumor reaches a stage where it takes on rapid growth and assumes a more or less malignant nature, when recurrences, metastases and involvement of the neighboring cranial and sympathetic nerves may be excited. At operation the tumor was so closely adherent to the external carotid that that vessel was doubly ligated and divided before it could be removed. Fortunately, the tumor had not advanced to the left, where it surrounds the vessels and renders ligation of the three carotids necessary to its removal. Of 54 operated cases the external carotid was ligated singly in 7 instances, and the three carotids in 32 cases. With the necessity of triple ligation, the mortality and complications from embolichal softening, secondary hemorrhage and injury to neighboring nerves increases very rapidly, and the death-rate reaches the proportions in all operated cases of 22 per cent. (12 deaths in 54, according to Callison and Mackenty's statistics).

The pathological report in this case was endothelioma or peri-

thelioma. These are the usual pathological findings. One case was reported as carcinoma. The demonstration of chromaffin cells by Kolmer clinched the pathological diagnosis of carotid tumor in our case.

PARTIAL COLECTOMY FOR INTESTINAL STASIS

Dr. John H. Jopson reported the case of a woman, aged thirty-four, who had been ill since November, 1911. Her symptoms were those of intestinal stasis, obstinate constipation, abdominal pain aggravated by eating; eructations, great loss of weight and quite marked neurasthenic symptoms. When first seen she was of a tall, thin, gastroptotic type of female, but this was largely due to the fact that she had lost 30 or 40 pounds within a few months. She had a marked secondary anæmia. In May, 1912, Dr. Jopson had removed her appendix which showed chronic interstitial changes, and separated numerous broad, thin adhesions between the first portion of the duodenum and the transverse colon which were causing a moderate obstruction of the first-mentioned portion of the bowel. The stomach showed no disease. She was not in the least improved by this operation, but continued with the attacks of gastric pain, gas, inability to take anything in the line of solid diet, and with some hyperacidity. The constipation became much more obstinate. Inflation of the stomach showed a very moderate ptosis.

The patient was placed on a modified rest cure in the hospital, but vomiting, abdominal pain and distress, and eructations continued.

In August, 1913, the abdomen was reopened. Careful examination showed that adhesions which were divided fifteen months previously had not reformed, the large bowel being remarkably free, except at the hepatic flexure of the transverse colon. At this point the bowel was acutely kinked; the ascending colon and transverse colon were bound together by adhesions of the same avascular nature as those discerned at the first operation. The ascending colon was much distended. The distal portion of the transverse colon and the descending colon were moderately collapsed, and there were a very few adhesions at the splenic flexure, which were divided.

The terminal portion of the ileum was divided and the cæcum and ascending colon and hepatic flexure and the first portion of the transverse colon were excised. A lateral anastomosis was performed between the terminal portion of the ileum and the transverse colon beyond the point of its division.

The patient made a good operative recovery, and when seen four months after operation she was greatly improved. She had gained about 16 pounds in weight. Her constipation was entirely relieved.

The stomach symptoms, indigestion, eructations, etc., were very much less and improvement was still progressing. She could eat a normal meal, at least once a day; and, while she still complained of some lumbar pain, especially marked on the right side, which she had had for several years and which was associated with a very movable kidney on this side, she was, comparatively speaking, a well woman in contrast to her condition before the first and second operations. Since then she has not been ill enough to consult her physician, although he recently heard from her to the effect that she was again having some gastric indigestion, mucus in the stools, and some of her old symptoms, so that the final result of the operation cannot yet be stated.

CYSTIC LYMPHANGIOMA OF THE GREAT OMENTUM

Dr. George W. Outerbridge (by invitation) read a paper with the above title, for which see page 680.

Dr. J. Stewart Rodman said that the case to which Dr. Outerbridge referred was one which occurred in his father's clinic and was reported in 1909. The diagnosis was presumably an ovarian cyst of enormous dimensions in a girl of seventeen, and at operation this cystic tumor seemed to fill the entire abdominal cavity; even after opening the abdomen it was still considered an ovarian cyst, but after evacuating the contents of the unilocular cyst it was seen that it did not originate in the pelvis but in the upper abdomen; and, finally, its origin was found to be between the layers of the great omentum, from which it shelled out rather easily. The patient made an uneventful recovery.

Dr. P. G. Skillern, Jr., remarked that there is a type of congenital mesenteric cyst that arises from anlage of tubules of the Wolffian body, which become sequestrated between the layers of the mesentery. An example of this type was reported by Dr. H. C. Deaver in the Annals of Surgery for May, 1909, page 619. It occurred in a seven-year-old school-girl, in whom symptoms of intestinal obstruction presented themselves. At operation three cysts the size of plums and with clear contents were found between the layers of mesentery in relation with the terminal loop of ileum, so embracing it as to cause the obstruction. It was necessary to resect ten inches of the ileum, together with the cysts. A lateral anastomosis was then performed.

In the differential diagnosis, mesenteric cysts are not uncommonly mistaken for ovarian cysts. In avoiding this error, it is helpful to ascertain if the tumor has grown from the abdomen towards the pelvis or *vice versa*, if an inferior zone of resonance can be obtained by the

Trendelenburg position, and if both ovaries are independent of the tumor.

If discovered accidentally, mesenteric cysts should be removed for prophylaxis of intestinal obstruction, and even for malignant degeneration.

There are four ways of dealing with intramesenteric cysts: (1) By aspiration; (2) by cystostomy and drainage, with or without the use of caustics; (3) by enucleation; (4) by resection of the involved intestinal segment. The first is obsolete because followed by recurrence. The second is useful in the presence of numerous adhesions. The third is ideal when practicable. The fourth is useful in the presence of multiple, juxtaposed cysts.

Dr. Astley P. C. Ashhurst asked Dr. Outerbridge whether the arcus magnus, corresponding to the free border of the omentum, was present in his case. That the diagnosis of omental cyst is sometimes made clinically is evidenced by this fact. He recalled hearing his father talk about a case at the Pennsylvania Hospital about twenty-five years ago: he said he had not seen the patient, but from what he had heard he had thought it must be a case of omental cyst, and of all the physicians and surgeons who had examined the patient in the hospital, no one but Dr. William Hunt had made the correct diagnosis. This diagnosis was confirmed by operation.

Dr. George W. Outerbridge, in closing, answering Dr. Ashhurst's question, said that he could not tell whether in this case there was a blood-vessel running along the free border of the omentum owing to the extensive development of cysts in this region, whereby the relations were largely destroyed. He thought the blood supply of the omentum undoubtedly varied enormously in individual cases, and that the conditions described would probably only be found in an occasional instance.

Regarding Dr. Skillern's statement that omental cysts are closely related to mesenteric cysts in the manner of formation, he would say that most of the true mesenteric cysts are likewise lymphatic in origin. Many of these have chylous contents, a condition not found of course in cysts of the omentum.

PERFORATED ULCERS OF STOMACH AND DUODENUM

Dr. George G. Ross said that it has so happened that between November 1, 1913, and the first of April, 1914, he had seen five cases of perforation of the stomach or duodenum, and one case which he believed was a perforation of the stomach on the posterior surface at

the greater curvature. There was, however, considerable doubt as to the correctness of the diagnosis, the case being the one that he reported to the Academy several meetings back.

The first case he reported was seen by him in consultation and was referred to the wards of the German Hospital, being operated upon by Dr. John B. Deaver during his clinic the same afternoon.

CASE I.—An adult man.

History.—Seven or eight years ago had an attack of indigestion which lasted for several weeks. He described this indigestion as follows: a fulness coming on immediately after eating and a feeling that he would be relieved if he could belch, but he could not belch. He was put on milk and toast at that time and some medicine, and after two weeks' treatment regained his normal health, except for constipation which had been the case throughout his life. About three months ago he began to have an uncomfortable feeling of fulness in his stomach, coming on immediately after eating, which was relieved by light diet. He was unable to belch; never vomited; passes considerable flatus. November 14, 1913, he ate a heavy lunch and was very uncomfortable during the afternoon. About 6.30 P.M., while sitting at a desk writing, he had a severe attack of epigastric pain, coming on suddenly and radiating up over the chest. He said his pain was constant, not spasmodic, and was made worse by inspiration. There was no nausea; nevertheless he attempted to empty his stomach by putting his fingers down his throat. He said that once last evening he felt like fainting but got to the outside air and averted it. His pain kept up all night, referred to the back of his neck and right shoulder. Drank a glass of warm milk this morning, retained it, and his pain was not exaggerated. Says bowels have been moving with purgatives but has not passed any flatus lately.

When admitted to hospital his eyes were sunken, pupils normal; heart and lungs surgically negative; abdomen distended, general board-like rigidity; liver dulness diminished; point of greatest tenderness midway between umbilicus and xiphoid: peristalsis present; extremities normal.

Operation.—By Dr. Deaver. Dorsal position. Iodine preparation. Low right rectus incision. Appendix adherent. Appendectomy. Gas and cloudy serum escaped when the peritoneum was opened. Purulent material appeared when the adhesions about the appendix were broken up. Culture taken. Upper right rectus incision. Gas bubbled out when peritoneum was opened. Perforation of the posterior surface of the duodenum. Duodenum was plicated with double linen. *Gastrohepatic* and *gastrocolic*

omentum stitched over ulcer. Upper abdomen wiped out with gauze. Posterior gastro-enterostomy done in the usual manner. Pelvis mopped out. Glass tube for drainage. Wound closed in layers to drainage. Dry dressing. Uneventful recovery.

This diagnosis was made in this case from the previous personal history, the character of the onset of the attack, the appearance of the man being hard hit, the location of the pain and tenderness, the board-like rigidity and the early appearance of distention, as demonstrated by the diminished liver dulness.

CASE II.—Female, aged sixty-eight, was admitted to the Germantown Hospital, January 26, 1914.

History.—For about three years she has had attacks of indigestion. These would occur every six or seven weeks and would last three or four days. For the last five months these attacks have been getting more severe and frequent. Recently they have occurred every week. Had a severe attack about one week ago, Monday, January 19. On Thursday following she had to go to bed. On Sunday she suffered intense pain in abdomen with constant vomiting. This continued until Monday morning, January 26, when she had a few hours' respite from vomiting; but in the afternoon the vomiting returned following the ingestion of a cup of broth. Bowels have not moved for seven days. Has always had trouble with her stomach since childhood, having spells of acute indigestion coming on three or four hours after eating, causing vomiting. For the last five or six years she has been unable to have a bowel movement without taking a purgative. She has had four children, all living and well.

When admitted her abdomen was tender, very little distended; visible peristalsis. Knuckles of gut could be seen through the emaciated, relaxed abdominal wall. There was very little audible peristaltic sound. The vomiting ceased upon withdrawal of all food and liquids by mouth. The case did not impress him as one of acute mechanical obstruction of the bowels and so she was not operated upon as an emergency case. His diagnosis was malignant growth of the sigmoid with partial obstruction. For several days she remained the same, excepting the failure to empty the bowels of fæces or gas. Her leucocytes were 10,300.

Operation.—Long incision. Right rectus muscle. No evidence of peritonitis, localized collection or malignancy in lower abdomen. A knuckle of ileum was found to be adherent to the stomach at the pylorus, and this, having become kinked, had given rise to mechanical obstruction. When the gut was freed from the stomach wall, a perforation of the anterior wall large enough to receive a lead pencil was exposed. There was no pus in the

locality and very little lymph. The perforation was closed by purse-string suture, oversewn with Lembert sutures of linen thread, and reinforced by a graft of gastrocolic omentum. Wound was close without drainage; gastro-enterostomy was not performed. Patient made an uninterrupted recovery and was discharged, 31 days after admission.

Dr. Ross said that he was unable to make a diagnosis in this case because he did not properly credit the previous history of stomach indigestion. She had stated that she had had trouble with her stomach since the age of 7, a period of 61 years. The pain of her perforation has occurred 8 days prior to her admission and all her symptoms at that time indicated a partial intestinal obstruction without marked toxæmia.

CASE III.—Adult, female; admitted to the Germantown Hospital, February 11, 1914.

History.—Was seized 48 hours before with intense pain in the upper abdomen. She described this pain as resembling a knife going through her stomach. The pain came on about five o'clock in the afternoon, after she had eaten her dinner. The patient states that during the day she had worked very hard. She was treated outside from Monday night until Wednesday afternoon, when she was admitted to the hospital. She stated that for the last 10 years she has been having pain after eating. This would come on immediately after the taking of food. She would belch sour material and would frequently vomit; vomiting relieved pain. Was admitted to this hospital in the Spring of 1913 and operated on for uterine fibroids. Following this operation the patient's symptoms were not relieved. No history of gastric ulcer in family. The abdomen was markedly distended, with rigidity and marked tenderness. The rigidity and tenderness were most marked in the epigastrium.

The abdomen was opened in the midline, from the ensiform cartilage to the umbilicus. A large subdiaphragmatic collection containing pus, lymph and stomach contents was opened. The collection was to the left of the suspensory ligament of the liver. When this was cleaned out a perforation the size of a silver three-cent piece was discovered on the anterior wall of the stomach, about half way between the greater and lesser curvatures and 3 or 4 inches from the pylorus. The perforation was closed by a chromic catgut suture and reinforced by two layers of Lembert sutures of linen thread. Gastro-enterostomy was not performed. The subphrenic abscess was thoroughly drained by two rubber tubes and three cigarette drains. A glass tube was placed in the pelvis through a button-hole incision. This

patient developed pneumonia, which was followed by an abscess of the left lung for which she was operated on by Dr. Francis T. Stewart, who stated that the abscess he opened was probably not the only one, as she continued to run some temperature.

CASE IV.—Male, age forty-two, admitted to the Germantown Hospital, February 28, 1914, about 2 A.M., suffering intense pain in the upper abdomen. Patient states that while at work lifting a heavy bar he was taken with a sudden pain in the epigastrium, which he described as feeling like being stabbed with a knife. Patient managed to get to a drug store where he was given some treatment by the druggist. A few minutes after the first dose he felt a little better and was then given a second dose. Following this he had intense pain which was sharp and excruciating, like the first. Before he left, the druggist gave him a dose of magnesium sulphate. He was suffering such intense pain that he was unable to get home, but managed to reach a cousin's house in Germantown where a doctor was called in. The doctor immediately washed out his stomach; a great deal of fluid was poured into the stomach but little removed. As the patient grew very much worse he was sent to the Germantown Hospital where a diagnosis of perforated gastric ulcer was made by the surgical resident, Dr. Williams, and Dr. Ross was notified and came out immediately and operated. White blood-cells were 24,000.

The patient had never been troubled with indigestion; never had pain before or after eating; always healthy. No history of gastric disturbances. Examination revealed a poorly nourished adult male, with abdomen markedly distended and rigid.

On opening the peritoneum, large quantities of gas and stomach contents escaped, including all three doses of medicine administered by the druggist, to say nothing of the washings of the doctor. Owing to the kindly ministrations of the druggist and doctor it was some time before the perforation could be located. It was finally discovered on the anterior wall, about one and one-half inches from the pylorus. The opening was closed as described in the other cases and a posterior gastro-enterostomy performed, because of some induration extending from the perforation to the pylorus, suggesting the probability of pyloric obstruction; also because the closing of the ulcer diminished the size of the pyloric end of the stomach corresponding to the area of the ulcer. The upper wound was drained by a cigarette drain to the site of the closed perforation and a counter drain by glass tube was placed in the pelvis to allow the various medicines, etc., to escape from the pelvis. For 18 days this man steadily improved; was on modified house diet and seemed to be getting

well. Then he developed peritonitis which seemed to start in the lower abdomen. He died on the twenty-second day after operation, of general septic peritonitis. Unfortunately no postmortem was permitted.

CASE V.—Male, aged twenty-three; admitted to the Germantown Hospital, March 26, 1914.

History.—His trouble began on March 20, 1914, with feeling of malaise. On March 21, he got worse, had a chill and had to go to bed. He then felt better and got up. His nose bled yesterday (March 25, 1914). To-day he developed his abdominal soreness and pain in back of head and neck muscles. This evening he vomited. No nausea now. No appetite, very thirsty; bowels normal; occasional short dry cough, but this does not persist. He expectorates very thick tenacious mucus which is mixed with a sort of black blood. No pain in chest; no dyspnœa; feet never swell; no palpitation. Abdominal pain makes breathing very painful. Passes less urine than usual and it is dark colored and burns a good deal; no frequency.

Inspection of the abdomen revealed a few scattered minute pustules. One point suggestive of a rose spot was found. Tenderness over epigastrium. A little abdominal rigidity. No tenderness over McBurney's point. A mass is felt in upper left quadrant, extending about 6 c.c. below costal margin, presumably spleen. Abdomen tympanitic throughout. Audible peristalsis.

On the third day thereafter there was much more rigidity with a definite point of increased tenderness in the epigastrium. He now says that he has had pain occasionally for three years when hungry and this was relieved by eating. He had a sore throat the day before yesterday. Movable dulness elicited, suggesting fluid in abdomen. He cannot rest on his left side now, as it is too painful. Some blood, small amount, expectorated. Patient was transferred to surgical ward with a diagnosis of left side subphrenic abscess, probably due to perforating ulcer.

Operation on March 30, 1914, by Dr. Ross, assisted by Dr. Cope. A right rectus incision was made from costal margin extending downward along the border of rectus muscle—six inches long. On opening the abdomen quantities of pus escaped, which was carefully sponged away. On examination of stomach it was found distended, seemingly by gas, but none was seen to escape. Along the fundus was found a large, massive lymphatic exudate which extended upward over anterior surface, including gastrohepatic omentum and from gastrohepatic omentum upward, involving under surface of liver and posterior surface and lesser curvature of stomach. The finger was passed through

gastrohepatic omentum and foramen of Winslow and a rough mass was detected on the posterior surface along the lesser curvature of stomach, which was taken to be a lymphatic exudate walling off the site of perforation. The different adhesions were broken up as well as it was possible to do so. On the left side of the suspensory ligament was found the abscess, which was directly underneath the diaphragm and between it and the liver. A cigarette drain was inserted directly to the right of the suspensory ligament to allow sufficient drainage of the subphrenic abscess. On the left two drains were inserted through the lesser omentum, one a cigarette drain and the other a rubber tubing, down to the site of perforation. The abdominal wall was then closed in the usual manner. As the abscess was definitely localized to the upper abdomen no drain was placed in the pelvis which proved to have been an error. The patient survived three days and then died of general suppurative peritonitis. The report of a partial postmortem follows:

The examination was of the abdomen and was performed through the incision made at operation for perforated gastric ulcer. The cadaver is one of an adult male, apparently thirty years of age, somewhat emaciated, with cheeks drawn and eyes sunken. Hair is normal; eyes, ears, and face show no special phenomena. The body frame is small and musculature is poor. Abdominal inspection: The abdomen presents an unhealed scar of the recent operation; and is flat, with little or no panicular adiposa and poor belly walls. Abdominal incision made by slightly enlarging the wound made at aforementioned operation. On inspection the whole abdomen presents the picture of a plastic suppurative exudate and older adhesions. This extends down into the pelvis and involves all the peritoneum. The pelvis contains about 20 c.c. of cloudy, flaky, serous fluid. The lesser curvature of the stomach is hemorrhagic; the gastrohepatic omentum shows a perforation about one inch in diameter; the entire upper abdomen is covered by a plastic exudate, while the jejunum and ileum are more free from this, but the great omentum is affected in the same degree with the upper abdomen. There is a bunch of small intestines firmly adherent in the pelvis. The appendix is normal. The cæcum and ascending colon are highly congested and firmly adherent to the wall. On section the stomach shows two small ulcers on the lesser curvature nearer the cardiac end; and one on the posterior surface which had perforated into the lesser peritoneal cavity. The duodenum is much degenerated and thin and presents one perforation about an inch in diameter on the posterior lateral aspect and still another about 2 inches in diameter on the anterior inferior surface. The lesser peritoneal cavity contained some fluid, while the peritoneum was markedly hemorrhagic. The wall of the duodenum is very thin in several places, having little more than the serous coat remaining. The liver and gall-bladder are normal. The kidneys are normal. The spleen is somewhat enlarged and shows hyper-

trophy of the lymphoid tissue. The intestines are congested throughout their entire length. No enlargement of Peyer's patches were found.

Summary of Findings.—1. Plastic and suppurative peritonitis. 2. Perforation into the lesser cavity. 3. Perforation in the duodenum. 4. Two ulcers on stomach mucosa nearer cardiac end.

The sixth and last case is the one in which the diagnosis is still in doubt, although the reporter was of opinion that it was a case of perforation of the stomach at the greater curvature on the posterior surface, in which there was erosion of one of the vessels running along the greater curvature accounting for the massive hemorrhage.

CASE VI.—Male, fifty-two years of age; there was nothing in his family history that threw any light on his case. He was a farmer and said he had been a little less strong than the average man of his class, not being able to lift so much. He had also been troubled with chronic dyspepsia and for some time past, when he leaned over, he had tenderness in the epigastrium. Two weeks ago, while at the dinner table, he had a pain in his epigastrium sufficiently severe to make him lie down. This continued during the afternoon, and although it continued through the night he obtained some sleep. The following morning at the breakfast table he had no desire to eat, and had an attack of excruciating pain so severe that it made him faint. When coming out of his syncope he vomited dark brown granular material resembling coffee ground vomit. He then sent for his physician who said the man had no rigidity at all of the abdominal muscles. He was tender in the right iliac fossa extending up toward the liver. The doctor wanted him to to go the hospital that day, but he did not come till the following morning, travelling some 40 miles. About 9.30 A.M. he was seen by Dr. Ross. His temperature was normal, pulse under 90; appearance rosy, lips pink; he had a leucocyte count of 11,000. There was absolutely no abdominal rigidity. He was tender, starting to the left of the median line at the epigastrium, going over to the right side and down to Poupart's ligament, dull in right flank and a little less dull in the left flank. There was no distention, but his belly felt full and doughy and a little dull to percussion. It was evident that he had a serious intra-abdominal lesion of some sort. Abdominal section was done at once. On approaching the peritoneum the bluish appearance of hemorrhage was seen. When the peritoneum was opened there gushed forth a tremendous amount of bright red blood, being more than in the ordinary case of extra-uterine pregnancy, followed by some thin, current jelly clot, while from the pelvis the clots were much darker and denser. The appendix was in-

spected and found normal. The small intestines were also normal as was the mesentery; the gall-bladder was normal. His gastrocolic omentum had an immense hæmatoma in it; between the layers of the transverse mesocolon there was another hæmatoma with a place in the left side which permitted the opening of his lesser peritoneal cavity in which was found some blood, and the posterior wall of the stomach, starting at the greater curvature, was infiltrated with hemorrhages.

The man is making a good recovery. A drain was introduced through the opening in the transverse mesocolon into the lesser peritoneal cavity and he is sitting up out of bed now, two weeks after operation, perfectly comfortable. An examination of his pancreas, made rather hurriedly because of his general condition, showed nothing abnormal. There was no evidence of effusion, no serum but comparatively fresh blood. The liver, so far as could be seen, was all right; hemorrhage from a pancreatic vessel would not explain the hæmatoma in the posterior layer of the stomach, nor would it account for the immense hæmatoma in the gastrocolic omentum. The veins around the stomach did appear very large but his conclusion was that the condition was due to a pin-point perforation at the greater curvature, going through the stomach wall and opening up one of the vessels on the greater curvature, the hemorrhage coming through the foramen of Winslow into the greater peritoneal cavity. The liver was not materially changed in size from the normal. There was an infinitely larger amount of blood in the greater peritoneal cavity than in the lesser.

This series presents several facts worthy of notice: Males, 4; females, 2; ages varied from 23 to 68. Time intervening between onset of symptoms and operation: longest period 8 days; shortest, about 11 hours. Of the two who died, perforation occurred about 6 days before operation. Of those recovering one had perforated 8 days before operation and in one two days intervened; in the third about 20 hours and in the fourth over 24 hours. Gastro-enterostomy was performed in two of the cases; one recovered (Dr. Deaver's case); one died (Dr. Ross' case). Site of perforation: Duodenum, 1; stomach, 3. Multiple ulcer of the stomach and duodenum with perforation of stomach ulcer and two perforations of the duodenal ulcers. The sixth case was gastric if the diagnosis of perforation is correct.

Dr. Morris Booth Miller reported the case of a man twenty-four years of age, who was admitted to the Polyclinic Hospital on January 22, 1913. He was taken suddenly ill with severe abdominal pain about

five o'clock in the afternoon. Previous history was that he had had attacks of pain over the region of his stomach for a number of months, but for about a month before this accident the pain had been more severe and had recurred more frequently. He, however, had no vomiting at any time before the day he was stricken. The painful attacks would occur about three hours after ingestion of food. He was constipated. When admitted to the hospital he presented that appearance which has been described aptly as one of abdominal tragedy, —sunken eye, pale face, anxious expression, with board-like, rather scaphoid belly, and tenderness marked in epigastrium and along the right flank. The operation in this case was performed about four hours after the perforation. As soon as the belly was opened the appearance of stomach contents and of gas was characteristic. The perforation was about the size of the end of a lead pencil and was situated about two inches beyond the pyloric vein and well over on the upper surface of the duodenum. On account of its depth it was difficult to catch and close, but he finally was able to close it with a double layer of sutures followed by a posterior gastro-enterostomy without a loop. The necessity of that procedure had come home to him through a lesson which he learned in a previous case, in which he was obliged to reopen to do a posterior gastro-enterostomy to cure a man whose pain and other symptoms persisted after a simple closure of the perforation.

Dr. John H. Jopson mentioned a case of perforation which developed a chronic lung abscess. Dr. Ross spoke of an acute lung abscess with drainage and recovery. In one case in which perforation had occurred some two weeks before he saw the patient and in which the attending physician had made a diagnosis of perforation, the perforation had eventually been walled off. At operation he found this condition—a subphrenic collection of cloudy fluid in the epigastrium, extending over the upper and under surface of the liver, which was covered with a thick fibrinous exudate. The perforation had been sealed over; it seemed to have been in the first portion of the duodenum. The area was drained, and in a short time the exudate broke down and the wound discharged thick pus. This diminished and the man was discharged with a sinus. A year later he died of brain abscess. At autopsy an old abscess was found at the base of the man's lung, adherent to the diaphragm. The pathologist's idea was that this abscess at the base of the lung was chronic, had antedated the perforation and was associated with pulmonary tuberculosis from which the patient suffered. Dr. Jopson was convinced that this infection had spread from below

upward and resulted in a chronic abscess of the lung and that the brain abscess was secondary to that, and this in turn secondary to the perforation of the duodenal ulcer.

Dr. George P. Müller reported the following cases of perforation of the stomach and duodenum.

Case I.—Occurred in a woman, twenty-six years of age, who presented a history of symptoms suggestive of gastric ulcer. She was given a thorough treatment by an osteopath and shortly after complained of acute symptoms over the gall-bladder, tenderness, rigidity, and finally the appearance of a mass. There was fever and increased pulse rate. At operation at the Chester County Hospital, October 23, 1909, a large, perforated ulcer was found. It was carefully sutured and the site drained. Symptoms of pyloric stenosis gradually appeared and finally became so intense as to demand operation a year later, at which time a posterior gastrojejunostomy was done. The patient immediately began to gain weight and now is in perfect health.

Case II.—Man, aged forty, who gave a typical history of duodenal ulcer for six or eight months previous to perforation. The symptoms of the latter resembled appendicitis and he had marked tenderness over the appendix upon admission to the hospital. Temperature, 101.8°; pulse, 88; respiration, 32; leucocytes, 17,700. The operation (University Hospital, December 18, 1909) was performed thirteen hours after perforation. The appendix was first exposed and found congested, but as turbid fluid was seen running down from above a second incision was made and the perforation discovered, two inches from the pylorus. The perforation was rather large and was closed with a purse-string catgut suture, reinforced with a catgut mattress suture; drainage was introduced to the site of suture, to the kidney pouch, and through a stab wound to the pelvis. Ten days later a duodenal fistula appeared and discharged bile and pancreatic juice, greatly excoriating the skin. Accordingly, a posterior gastrojejunostomy was done through a second incision and in a week the fistula had closed. Patient was discharged 31 days after operation with the wounds practically healed.

Case III.—Man, aged fifty-five, without any previous history whatever of dyspepsia. He was suddenly seized with pain in the epigastrium and marked rigidity. There was tenderness over the gall-bladder region and the pain was referred through to the back. On admission to the hospital temperature was 98.6°; pulse, 90; respiration, 28. Perforated duodenal ulcer was diagnosed and operation performed three hours from the time of perforation

at the University Hospital, July 12, 1910. A small perforation was found and closed with silk and the site of perforation drained. Patient was discharged five weeks after operation with wound entirely healed.

CASE IV.—Admitted to the St. Agnes Hospital during 1912. She was a woman, thirty-five years of age, who for some time had had dyspepsia and was then seized with pain followed by symptoms of peritonitis, although they were not recognized by the attending physician. She was sent in as a case of intestinal obstruction, about one week after the onset of symptoms, and the abdomen opened under local anæsthesia under that impression. A large perforation in the anterior wall of the stomach was found and also a general suppurative peritonitis. A rubber tube was sewed in to the perforation and nothing else done. Patient died in three hours.

CASE V.—Man of sixty-eight years who had suffered for some years from attacks of pain after eating and accompanied by belching. On April 20, 1912, he was suddenly seized with severe pain over the liver, radiating to the right shoulder, followed by vomiting and then by some distention of the abdomen. Temperature rose to 101° and remained about that figure. Vomiting continued and the distention increased; patient was never shocked and seemed bright and cheerful. Three days after the onset of symptoms he was seen by Dr. Müller, he was complaining of abdominal pain, mostly in the right iliac fossa, with persistent nausea and vomiting of black material. The abdomen was tightly distended. At operation (Presbyterian Hospital, April 23, 1912) there was found a very small perforation in the anterior wall of the duodenum. This was closed with linen and catgut reinforced by a tag of omentum. In addition he had a general purulent peritonitis, especially in the upper portions. The site of anastomosis was drained and the pelvis was drained, but the patient died twelve days after operation with symptoms of increasing toxæmia and perhaps of subphrenic abscess. We were not allowed to operate a second time and were not allowed to perform an autopsy.

CASE VI.—Man, thirty-eight years of age, who gave a vague history of previous indigestion. While at work he was suddenly seized with pain in the epigastrium, followed by vomiting, and on admission was extremely rigid in the epigastrium and had tenderness over the gall-bladder. Temperature was 99°; pulse, 100; respiration, 20; leucocytes, 20,700. The lesion was correctly diagnosed and the patient operated upon one and one-half hours from the time of perforation. At operation (Polyclinic Hospital, September 24, 1913) a small perforation of the anterior wall of

the duodenum close to the pylorus was found. The perforation was closed and a posterior gastro-enterostomy performed and the site of perforation drained. A second drain was introduced to the pelvis. He was discharged in a few weeks with wounds entirely healed.

It will thus be seen that of the four cases which recovered, three were operated upon at a very early period and in the fourth, localization occurred, saving the patient. The reporter believes that a primary gastrojejunostomy should be performed if feasible, that is, if the operator is skilful enough to avoid extensive soiling of the peritoneal surfaces and if time is not an important element affecting the prognosis. It is interesting to note the almost immediate cure of a duodenal fistula by gastrojejunostomy.

In addition to these six acute perforations he had had two examples of what might be called chronic perforation.

The first occurred in a woman of twenty-two, with a typical history of ulcer, who was treated medically for some time with relief, but with recurrence. At operation (University Hospital, October 8, 1913) a duodenal ulcer was found which by reason of scarring and infiltration had produced some stenosis. In addition an ulcer of the posterior wall just below the lesser curvature had perforated the entire stomach wall, the infiltrated transverse mesocolon forming the base of the ulcer. The latter had almost perforated and, accordingly, the mass of infiltrated mesocolon together with the ulcer was excised. The wound in the stomach was closed and just posterior to it a no-loop gastrojejunostomy was performed in the usual manner. This patient seems to have made a perfect recovery. She had hemorrhage from the stomach two weeks after operation but recovered therefrom and is now doing well.

The second case was most interesting. It was in a man fifty years of age, who following an attack of dysentery began to suffer from pain in the upper abdomen which, during three years, gradually developed into a typical case of duodenal ulcer. At operation (University Hospital, November 19, 1910), a mass of adhesions was found in the region of the pylorus but no evidence of ulcer, although the pyloric end of the stomach felt thick and beefy and the duodenum was dilated. The adhesions were separated and the wound closed. Through a second incision a thickened constricted appendix was removed, the omentum being adherent. The patient improved and recovered from operation and for some time did well, but gradually the symptoms recurred,

FIG. 11.—Congenital perforations of the parietal bones (external aspect).

FIG. 12.—Congenital perforations of the parietal bones (internal aspect). Thinness of bone shown by light area behind left foramen.

although there was some difference, as the pain was noticed more immediately after eating. After several years of medical treatment, a radiogram by Dr. Pfahler diagnosed a perforated gastric ulcer together with evidence of adhesions, etc. At operation at the Chester County Hospital, May 2, 1914, a perforated ulcer of the posterior wall was found surrounded by a small mass of exudate which in turn was adherent to the pancreas. The ulcer and a portion of the stomach was excised and the wound closed. Because the operation took time and owing to the difficulty in separating the adhesions and the presence of much oozing, it was deemed inadvisable to perform gastrojejunostomy at that time.

CONGENITAL PERFORATIONS OF THE PARIETAL BONES

Dr. Penn G. Skillern, Jr. presented a calvarium, discovered in the dissecting room of the University of Pennsylvania, which presented a very rare condition, and one that would give rise to confusion clinically were its occurrence not borne in mind, namely, congenital perforations of the parietal bones. In a review of the subject in 1902, Piersol (*Univ. of Penna. Med. Bull.*, August–September, 1902) described and illustrated a case, and was able to collect but fourteen other specimens.

In this case (Fig. 11) the perforations are irregularly round, and very symmetrical as to size and position. Both occupy the centre of a depressed area, which readily transmits light (Fig. 12). The edge of each perforation is as thin as paper, and the surrounding bone increases in thickness until the periphery of the depressed area is reached.[1] On the right side the perforation measures 14 mm. transversely and 12 mm. anteroposteriorly, and readily admits the tip of the little finger. It is situated 3.5 cm. from the sagittal suture. On the left side the perforation measures 15 mm. transversely and 13 mm. anteroposteriorly, and admits the tip of the index. It is situated 2.5 cm. from the sagittal suture. Each perforation was filled in by the epicranium externally and the dura internally, both of which were inseparably blended.

These parietal perforations are probably due to an exaggeration of the local disturbance of ossification which ordinarily results in the formation of the normal foramina, induced by unusual intracranial pressure within the immature skull. Welcker and Toldt (*Spee. Skeletlehre, Bardeleben's Hands. D. Anat. D. Menschen.*, 1896, Band 1.,

[1] Prof. Geo. A. Piersol, who examined this specimen, suggested that this progressive thinning represented an attempt at complete filling of the defect by ossification.

S. 114, cited by Piersol) state that the normal development of the parietal foramina is closely associated with a cleft, usually about 5 mm. deep, on the mesial border of the young parietal bone. Within this cleft lies a perforating blood-vessel, commonly the emissary vein, which obstructs ossification at that point and causes the separation of the rays of developing bone. The subsequent closure of the fissure proceeds from the sagittal suture outward, the lateral or outer end of the cleft persisting as the parietal foramen. Piersol states that the generally recognized close relation between parietal perforations and parietal foramina admits of little question, especially when we consider the similarity of position, the symmetrical form and disposition of the apertures, as well as the observed gradual transitions from the large foramen to the huge hole.

Clinically, such perforations, were their occurrence not borne in mind, would cause confusion in palpation of the skull, in which the pulsations of the brain may be felt, in the examination of lacerated wounds of the scalp for underlying fracture of the skull; in the exposure of this area of the skull at operations; and in the examination of skiagrams of the skull.

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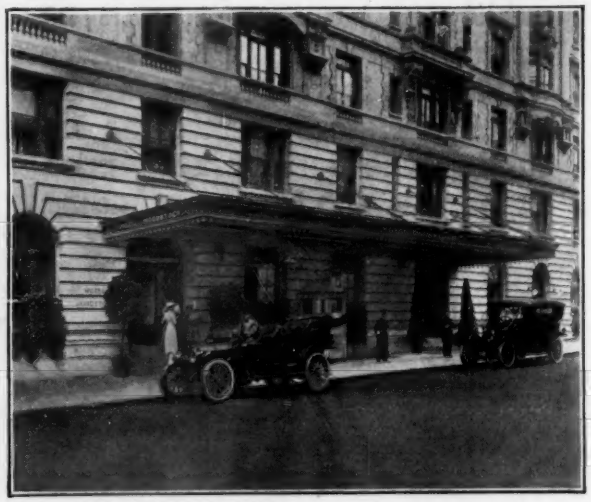

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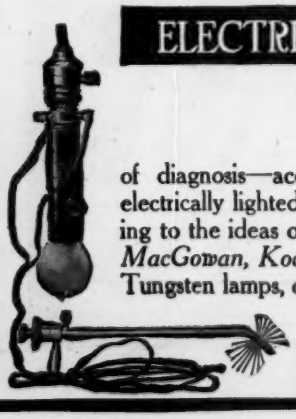

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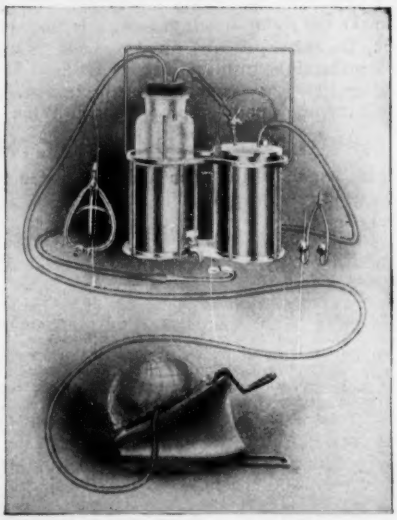

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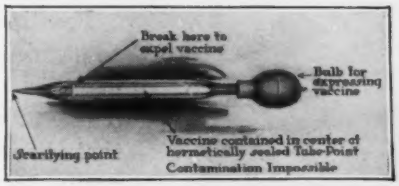
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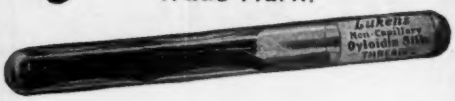

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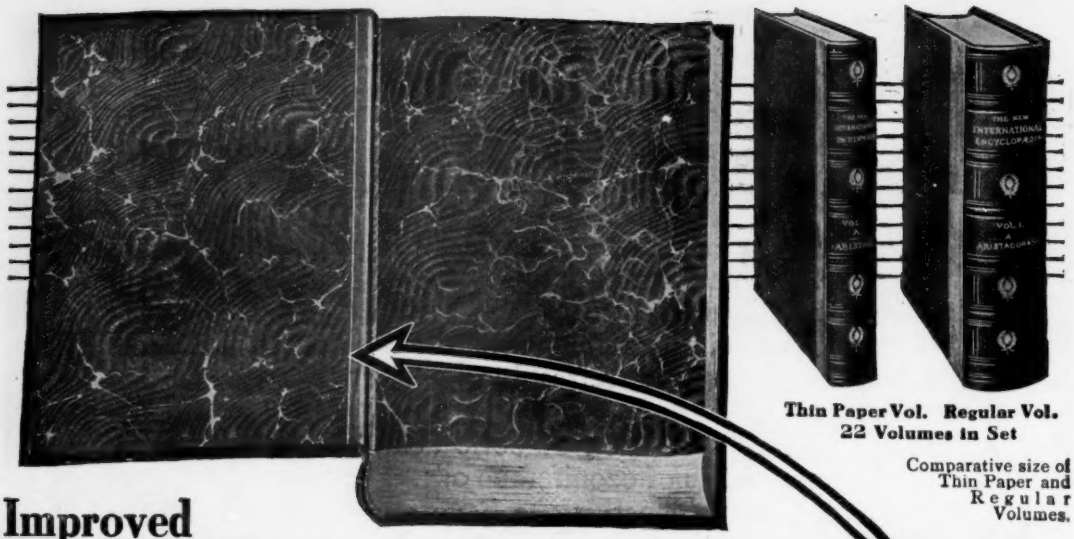

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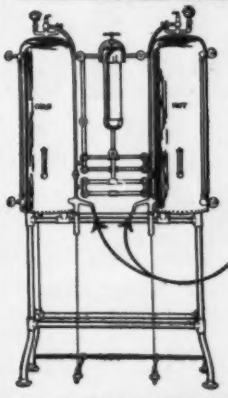

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